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ABSTRACT

This curriculum guide is designed for educators who want to teach youths aged 5-18 about the interactions among energy, economics, and the environment. This guide contains five chapters of activities, each focusing on a different topic related to this interaction as well as several sections that guide session leaders in helping youth along the learning process. The guide begins with two sections: (1) "Developing Caring Kids," which describes the developmental characteristics of youth in terms of ecological stages; and (2) "Leading Your Best". An activity matrix provides information on leader requirements, goals, and age range for the various activities. Each chapter of activities begins with a background section that provides a basic understanding of the topic. Chapters include: 1) "Energy Basics"; 2) "Energy Sources"; 3) "Wild Energy"; 4) "Efficient Worlds"; and 5) "Global Issues, Future Trends". Another section offering leader strategies entitled "Energize Your 4-H Project Area!" provides specific ideas to share with youth to help them design science fair projects. A final section, "Train the Trainer", provides suggestions for holding six- or 12-hour workshops on this curriculum for session leaders. Materials include sample agendas, handouts, overheads, and icebreakers. (Contains a glossary and a list of Energy Education Resources) (PVD)

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Energizing your future with energy, economics and the environment!

"National 4-H Council is building partnerships for community youth development that value and involve youth in solving issues critical to their lives, their families and society. This new mission emanates from the belief that young people are vital resources and assets as partners in the development of healthy, sustainable communities. As youth assume meaningful roles in the process of developing communities, they become invested in their future, the people with whom they live, their surroundings, and the larger society. As we listen to our nation's young citizens, we come to understand their unique perspectives about issues critical to all of us."

This program was graciously underwritten by the Amoco Foundation without whom this program would not be possible.

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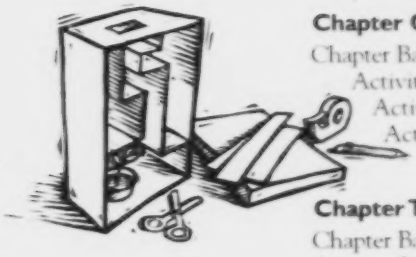

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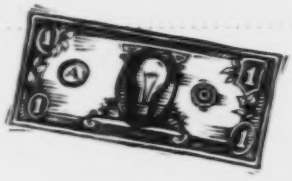

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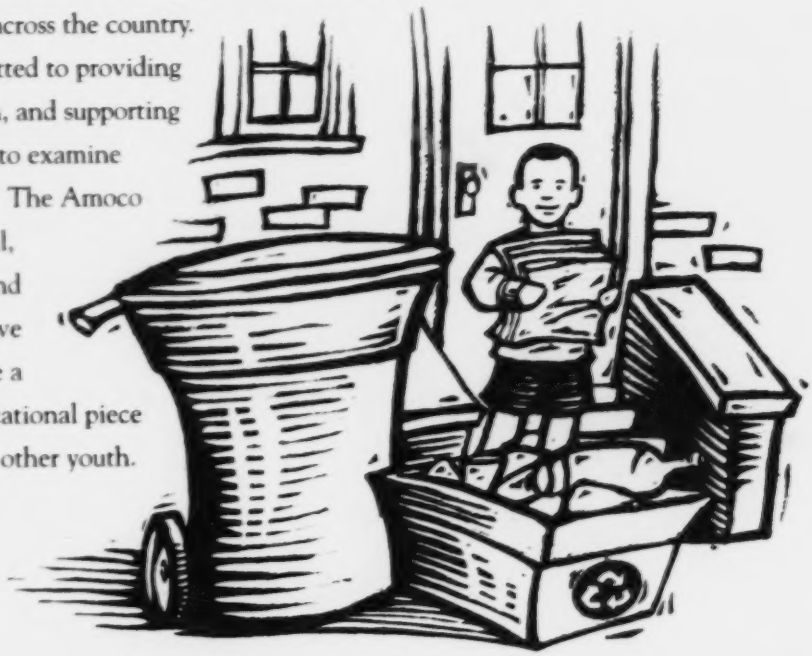
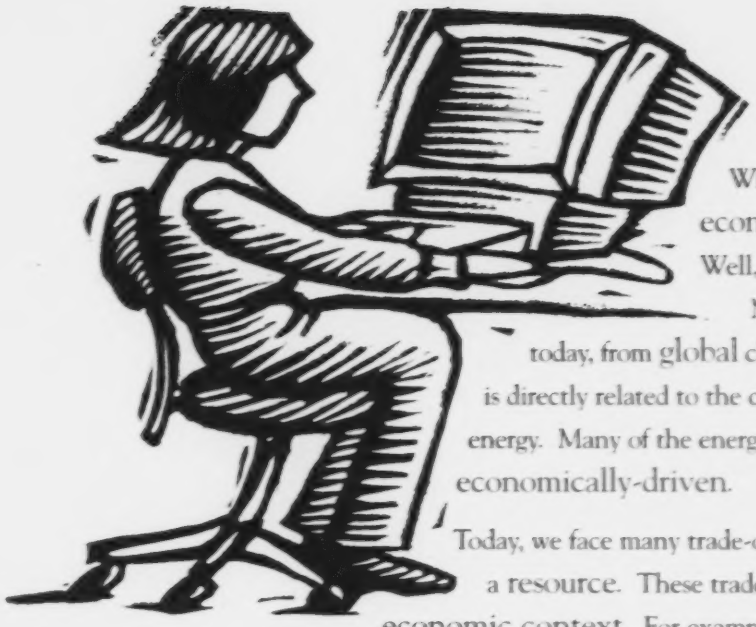
Welcome!

Welcome to *Energizing Your Future with Energy, Economics, and the Environment* Leaders' Guide! This guide will help you teach youth about the interactions among energy, economics, and the environment. It is intended to help reinforce concepts and give youth additional opportunities for making discoveries on their own.

This curriculum is part of the Environmental Stewardship program at National 4-H Council. The program encourages youth to make a commitment to use natural resources responsibly so they can contribute to the quality of life for present and future generations. The program prepares youth to be environmental stewards. Environmental Stewardship publications provide a sound ecological foundation for information and knowledge. They also help youth examine their own and others' values about the environment by exploring contemporary issues. Throughout the program, investigation, evaluation, critical thinking, and judgment skills are emphasized, as are the development of environmental action skills—the hallmark of a true environmental steward.

This curriculum received major support from the Amoco Foundation, which partnered with National 4-H Council to bring the issues of energy, economics, and the environment to children across the country. The Amoco Foundation is committed to providing educational opportunities to youth, and supporting their use of critical thinking skills to examine environmental educational issues. The Amoco Foundation, National 4-H Council, Curriculum Review Team, and Pilot Partners are pleased to have been a part of the effort to provide a balanced, thought-provoking educational piece for use by the nation's 4-Hers and other youth.





Why did we pick the topics of energy, economics, and the environment? Well, it's clear that the three are interrelated. Nearly every environmental issue today, from global climatic change to habitat preservation, is directly related to the conversion and consumption of energy. Many of the energy use choices we make are economically-driven.

Today, we face many trade-offs when deciding how best to use a resource. These trade-offs are often considered in an economic context. For example, consider the curriculum before you. We could have chosen to laboriously hand write every page. For every person who wanted a copy, we would have had to rewrite and redraw each page, a decision that would require more resources than is efficient. We chose instead to use electricity (in this case, provided by the burning of coal) to run a computer and printer. This saved us time and human effort. The trade-off was that our use of electricity added sulfur dioxide and other pollutants to the atmosphere. We were willing to accept this trade-off, because we decided that the advantage of having readily available books about energy and decision making far outweighed the immediate negative impacts on air quality.

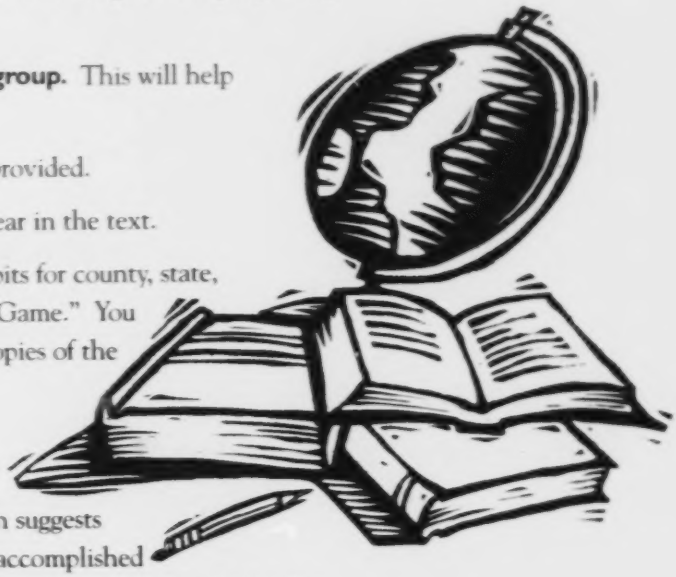
We all face similar decisions daily. How today's youth balance such trade-offs as adults will dramatically affect the environment and economy of their communities, regions, and world. It's important that youth learn how to take a balanced approach to solving the complex energy and environmental problems they'll encounter in the years ahead. By helping youth develop stewardship skills today, you're helping to create skilled, environmentally aware leaders for tomorrow.

About the Curriculum

The *Energizing Your Future* Leaders' Guide is for youth ages five to 18. This guide contains five chapters, each focusing on a different topic related to the interaction among energy, economics, and the environment. The chapter and activity matrix on the following pages provides information about leader requirements, goals, and intended age range for the various activities.

We recommend the following strategy for using this curriculum:

- **Decide, with group input when possible,** whether the activity will be led by teens, adults, peers, or the learners themselves. Information about suitability of the various approaches is found in the text box at the beginning of the activity.
- **Review the last session,** especially if it is a recommended pre-activity. This helps all participants arrive at a common point of knowledge before progressing to new information.
- **State and agree upon the objective for the group.** This will help everyone focus on the learning goal.
- **Carry out the activity,** following instructions provided.
- **Summarize learning,** using questions that appear in the text.
- **Provide children with some options** for exhibits for county, state, or science fairs with the material found in "Fair Game." You can either read the section aloud or distribute copies of the text.
- **Read "One for All and All for One"** aloud to participants to stimulate their interest in improving and shaping their world. This section suggests club, home, or community projects that can be accomplished by a group of children and adults. In carrying them out, children will develop skills for protecting the environment.



At the back of this book, you'll find information that will help you to incorporate energy, economics, and environmental concepts in 4-H projects and to train others to lead sessions with youth. "Energize Your 4-H Project Area!" provides specific ideas you can share with youth to help them design country, state, science, or art fair projects. "Train the Trainer" offers suggestions for holding a six- or 12-hour workshop on this curriculum for those who will lead the sessions. The materials include sample agendas, handouts, overheads, and icebreakers.

Developing Caring Kids

Research suggests that people begin to care about the environment only when their personal needs — such as sustenance and security — are being met. Slade[1] described the following "ecological stages" in children:

Ages 1 to 6 *(approximately)*:

The ecological self establishes nature as a safe, predictable place. The self looks for patterns in nature and learns basic laws by experience (e.g., swat bee, bee stings). There is an ecstasy in nature that is actually a pure openness, striving to understand. The self comes to understand what the pieces of nature are. Animism, the sense that anything that moves is alive, is strong.

Developmental Characteristics of Youth Ages 5 to 8 [2]

Characteristics	Implications for Teaching and Leading
➤ Easily motivated, eager to try something new. Live in the present and have a short interest span.	*Plan a wide variety of activities. Move quickly from one brief activity to another. Build each experience upon a previous activity. Plan and encourage free time.*
➤ All new learning involves use of language.	*Be specific and clear with instructions. Ask for feedback to check comprehension.*
➤ Sensitive to criticism; don't accept failure well.	*Provide positive encouragement and help. Plan many activities in which they can experience success. Foster teamwork rather than competition.*
➤ Experimental, exploratory behavior is part of development. Learn best when physically active.	*Use field trips, models, and hands-on experience. Provide activities that encourage small and large motor skills such as running, jumping, painting, and using scissors.*
➤ Strong desire for attention and affection of adults.	*Have plenty of adult or older teen helpers. A ratio of one adult or teen to every three to four children is best.*

[1] Andrew Slade, "Abraham Maslow and the Ecological Self," in *Confronting Environmental Challenges in a Changing World*. St. Paul: (North American Association for Environmental Education, 1991).

[2] Adapted from U.S. Department of Agriculture, *Youth Curriculum Sourcebook*, EFNEP 4-H (Washington, DC; May 1994).

Ages 7 to 14 (approximately)

The self begins to appreciate a "community of life." The self moves from an apprehension of wild animals to a growing emotional attachment. A landscape represents a place to play, not an aesthetic pleasure. If the landscape is steep, foreboding, or scary, the self does not like it. The self tends to favor parklike, savannah environments.

Developmental Characteristics of Youth Ages 9 to 11

Characteristics	Implications for Teaching and Leading
➤ Are active, with boundless energy. Are easily motivated, eager to try something new.	*Emphasize hands-on learning. Keep youth busy with individual or group projects and group free time.*
➤ Like group activity, but like to be with members of own sex.	*Emphasize group learning experiences, especially those done with members of the same sex.*
➤ Have interests that change rapidly, jumping from one thing to another.	*Encourage many brief learning experiences. Lay out work in small pieces.*
➤ Guidance from parents and adults is important if youths are to attend to a task and achieve their best performance.	*Provide opportunities for parent involvement. Outline "things to do" and make assignments.*
➤ Admire and imitate older boys and girls.	*Encourage apprenticing with teen volunteers.*
➤ Are extremely curious. Constantly ask "why?"	*Don't worry about answering all the questions. Serve as a resource for learning. Help participants use books, libraries, catalogs, and computers to find information.*

Ages 12 to 18 (approximately)

Here is the transition from the intuitive sense of belonging to nature to the intellectual sense. The self feels separate from nature, able to survive. Knowledge grows dramatically. The self is attracted to landscapes both for their own beauty and for the potential for risk and excitement. The self appreciates its own setting more than earlier. Activism is strong but is based on a sense of self-preservation. This is where development commonly stops for a person with an average amount of experience in nature, related education, and overall psychological health.

Developmental Characteristics of Youth Ages 12 to 14

Characteristics	Implications for Teaching and Leading
➤ Are concerned about physical development and being liked by friends. Want to be independent, yet still need parents' help.	*Encourage learning experiences related to understanding themselves and getting along with others. Encourage apprenticing and working with adults and older teens to complete learning experiences.*
➤ Are self-conscious and may have feelings of inferiority.	*Concentrate on developing individual skills.*
➤ Are getting over the age of fantasy and beginning to think of what they will do when they grow up, but are unclear of needs and values.	*Relate what they are doing to career choices.*
➤ Are interested in activities involving boys and girls. Like sports and active games.	*Encourage active, fun learning experiences that involve both boys and girls.*
➤ Are ready for in-depth, longer learning experiences.	*Choose tasks that are more difficult and lengthy. Provide hands-on and skill-centered experiences in specific subjects.*

You can use this information to better understand the age groups you are working with. Children ages 12 and up are suited to large community environmental stewardship projects because of their need to belong and make their lives better. Younger children can only understand the most basic energy concepts, since they see nature as pieces and parts. Children of all ages benefit from having a caring adult who leads by example and instills wonder.

The following information will help you better understand the developmental characteristics of the youth you will be working with.

Developmental Characteristics of Youth Ages 15 to 18

Characteristics	Implications for Teaching and Leading
➤ Have high social needs and desires. Want and need a strong voice in planning their own program. Want adult leadership roles.	*Emphasize leadership life skills that also relate to social development. Provide opportunities for self-expression. Encourage youth to plan programs with guidance and support of adults. Encourage working with adult role models.*
➤ Have areas of interest that are more consistent than earlier, with patterns becoming more definite. Often need guidance in selecting careers.	*Encourage greater in-depth study of content, leadership roles, and life skills. Encourage career exploration in specific subjects.*
➤ Are developing community consciousness.	*Encourage learning activities involving the community.*

Leading Your Best

Many of the activities in this manual are facilitative. In other words, your job as teacher or leader is to help along the learning process, rather than lecturing and encouraging memorization. You do not need to be an expert on energy, economics, and the environment. You merely need to be able to help youth find the answers they seek.

An important part of your job is recognizing and motivating environmental learning and stewardship behavior in youth. Motivation can take one of two forms: intrinsic or extrinsic. Children are motivated intrinsically when they do a project to feel better about themselves or to enjoy a sense of mastery. They are not looking for applause or money. Children are motivated extrinsically when they complete a project for public acknowledgment or other external reward. Everyone needs to be recognized — it's a basic human need. Recognition encourages and supports learning and skill development. Strive to recognize youth in all learning situations.

In environmental stewardship activities, it's often more appropriate to recognize youth for cooperation than for competition. Working together is a key part of solving environmental problems.

Remember that recognition can take many forms. Some youth like to be publicly recognized; others prefer individual, private "pats on the back." Respect differences in personality and background when recognizing accomplishments.

The following information, adapted from the National 4-H Recognition Model, reviews types of recognition you might wish to use with this curriculum.

- Recognize children for *participation*. This acknowledges their involvement in the first step of working toward a goal and builds a positive self-image.
- Recognize children for *progress toward their personal goals*. This helps youth gain experience in setting goals and realistically assessing their abilities.
- Recognize children for *achieving standards of excellence*. These predetermined targets give youth something to aim for in their learning experiences.
- Recognize children through *peer competition*. This can be a strong motivation for some children. It is not appropriate for youth under age 8.
- Recognize children for *cooperating*. This is especially important in learning environmental action skills.

Chapter and Activity Matrix

The following table shows appropriate teaching arrangements, age groups, and learning goals for each activity.

ACTIVITY	GOALS	Adult Led	Teen Led	Self Led	Ages 5-8	Ages 9-12	Ages 13-18
Chapter One Energy Explorations	*To define energy and describe its characteristics.*	✓	✓		✓	✓	
Pole Bean Races	*To demonstrate that the sun provides energy to the earth.*	✓	✓		✓	✓	
Energy Diaries	*To understand food is energy.*	✓	✓		✓	✓	
Blue Boat Takes a Ride	*To explore different sources of energy.*	✓	✓		✓	✓	
Chapter Two Between a Rock and a Hard Place	*To discover different technologies used to capture and extract energy resources.*	✓		✓		✓	✓
A Dip in the Pool	*To define and give examples of renewable and nonrenewable sources of energy.*	✓	✓			✓	✓
Fact or Foil	*To know that energy is found in many forms.*	✓	✓			✓	✓
Energy!	*To examine U.S. sources and uses of energy.*	✓	✓				✓
Chapter Three What is a Wilderness Area Worth?	*To understand and list ways natural resources provide environmental quality.*	✓	✓			✓	✓
Auctioning Energy	*To demonstrate how natural resources such as energy are subject to the laws of supply and demand.*	✓	✓			✓	✓
Frozen Pizza or Frisbees?	*To understand the term trade-off and give examples in environmental and energy use decisions.*	✓					✓
Chances and Choices	*To demonstrate that natural resources such as land have several alternative uses. To describe the trade-offs involved in choosing one alternative over another.*	✓					✓

ACTIVITY	GOALS	Adult Led	Teen Led	Self Led	Ages 5-8	Ages 9-12	Ages 13-18
Chapter Four No Wasted Work	*To define efficiency as getting the most out of something.*	✓	✓		✓	✓	
88.5 Quadrillion and Counting	*To analyze how individuals can become energy efficient and how this affects their well-being.*	✓	✓	✓		✓	✓
Tennis Shoe Blues	*To examine the energy inputs into a single consumer product.*	✓					✓
Chapter Five Global Lights	*To gain awareness of world energy consumption, production, and environmental problems.*	✓	✓			✓	✓
A Matter of Invention	*To discuss global options for alternative sources of energy.*	✓				✓	✓
Eons of Energy	*To understand the changes that have occurred over time in our energy sources.*	✓	✓			✓	✓
Horses Set Courses	*To examine energy predictions.*	✓	✓			✓	✓

notes: _____

Chapter 1

Energy Basics

Energy Moves! Energy gives the bees their buzz and the hula to the hoop. Energy drives, glides, slides, rows, mows, shines, cooks, and moves the world. Energy hip hops, belly flops, climbs mountain tops, and go-go-goes all day and all night long.

Energy takes many forms. Mechanical energy makes things move. It is as simple as a breath from a baby that scatters dandelion seeds, or as complicated as a hydraulic lift raising a car. There are two types of mechanical energy — potential and kinetic.

Potential energy is a crystal vase in wet hands. Kinetic energy is the vase falling towards the ground.

Chemical energy is energy stored in chemical bonds. Food, coal, wood, and other things contain chemical energy. When plants photosynthesize, they convert solar energy to chemical energy. Electrical energy is moving electrons. Electricity is often generated from coal, moving water, nuclear fission, or natural gas.

Radiant energy is visible light. It also is infrared light, micro-waves, and television and radio waves. Thermal energy is heat. Heat is a form of kinetic energy — the energy of moving molecules. The hotter an object becomes, the faster the molecules move.

Nuclear energy is the energy that binds parts of the nucleus of an atom together. This energy is released when atoms are merged or split apart. Nuclear energy generators split atoms to generate heat that is used to generate electricity. Nuclear energy from combining atoms provides the energy for the sun.

Play It Again

When we grow trees for firewood or harness the wind to move our sailboats, are we making new energy? No! The First Law of Thermodynamics states that energy can't be created or destroyed; it can only be converted from one form to another. When you eat a shiny, red, carbohydrate-rich snack (otherwise known as an apple), you are converting much of the chemical energy in the food to chemical energy in your body. Some of the energy is dissipated to the air as heat. And some (in the form of uneaten apple core) is retained as unused chemical energy to be used later by other organisms (e.g., a dog digging through garbage or decomposing bacteria.) The apple may be gone, but the energy remains.

Energy and Children

Young children may have difficulty understanding the concept of energy. They tend to think of energy as something concrete, like water. But energy is far more complicated than that! The important point is that energy helps people and other things "do work." Children ages seven or eight may ask questions such as "What makes a car go?" or "What makes a clock run?" Developing curiosity about energy will help children begin to understand a wide variety of science mysteries!

ACTIVITY 1.1

Ages: 5 to 12

Style: adult or teen led

Life Skills: trying new things; building a base of experiences; working together cooperatively; gathering information to solve problems; developing intellectual curiosity; asking questions; predicting outcomes of situations; refining small motor skills; learning to use tools and other objects

Pre-Activities: none

Time Needed: varies

Group Size: any

Indoors or Outdoors: varies

Materials Needed:

Exploration One: rubber balls, access to stairway.

Exploration Two: peanuts or walnuts, pie pan, lighter, clamp, stand, thermometer, chalkboard and chalk or flip chart and marker.

Exploration Three: paper cups, lima bean seeds, soil, water, small paper bags.

Exploration Four: paper cups, water, popcorn, sand, soil.

ENERGY EXPLORATIONS

ACTIVITY GOALS

To define energy and describe its characteristics.

Preview

Children explore mechanical, chemical, radiant, and thermal energy by doing simple experiments.

Note that Exploration One requires the use of a flame. Take appropriate precautions to keep children safe.

How to Do the Activity

What is energy? Energy, simply put, is the ability to do work (or play!). Without energy, children wouldn't be able to make their beds or do their homework. Without energy, ovens wouldn't heat and cook. Without energy, the world would come to a grinding halt.

Ask children to define energy. What are some things energy helps you do? (Move, grow, make things work.) What is your favorite thing to do that you need energy for? How do you get energy? (From food!)

Explain to participants that they will be exploring different types of energy. There are many types of energy, but they will focus on mechanical, chemical, radiant, and thermal energy. Explain each type as you do the explorations below. You may chose to do all of the explorations, or focus on one or two.

Exploration One *(10 minutes)*

What is mechanical energy? (See "Chapter Background".) To explore the answer to this question, give each child a rubber ball. Have children position their balls at the top of a stairs.

Explain that ball contains energy. Now let the children gently push their balls. The energy in the ball is moving it towards the bottom of the stairs. The energy is there because the top of the stairs is higher than the bottom. (With older children, explain that the ball at the top of the stairs has potential energy. The ball moving down the stairs has kinetic energy).

Exploration Two *(20 minutes)*

Chemicals contain energy. Calories (actually kilocalories) are measures of chemical energy in food.

Working indoors under controlled conditions, put a handful of peanuts or walnuts into a pie tin (see illustration). Rest the pie tin on a surface that can take heat, such as a pot holder or ceramic cutting board. Using a stand with clamps, suspend a tin can half filled with water slightly above the food. Ask participants to stand back several feet because you will be using fire.

Take the temperature of the water. Write this temperature on the chalkboard or flip chart. Ask the children if there is energy in the nuts. Do they get energy from food? Do they think the nuts have enough energy to raise the temperature of the water? Record their "hypotheses"— how many children think the peanuts will raise the temperature of the water, and how many don't.

Apply a lighter to the peanuts until they catch fire. Hold the thermometer in the water while the peanuts are burning. Do not touch the thermometer to the sides of the can. After the peanuts have burned, record the temperature of the water. Is it higher or lower? Why did the peanuts burn? (Because they contained chemical energy.) Did the children hypothesize correctly?

Exploration Three

(20 minutes initially; two week observation)

Radiant energy in the form of light comes from the sun. Plants use the light to make food.

Divide children into teams of two. Give each team two paper cups, two lima bean seeds, some soil, water, and a small paper bag. Let them plant one seed in each cup and water them. Teams should place one in full sunlight. They should cover the other with the paper bag and place it where it does not receive any sunlight.

Teams should water both cups regularly. After about two weeks, let them compare the plants. The lima bean that received sunlight was able to make food and grow strong. The lima bean that didn't receive sunlight became etiolated. It looks pale and spindly because without the sun, it couldn't make the food it needed. Explain that plants need light energy to grow.

Exploration Four

(25 minutes, 90 minute wait time)

Thermal energy is heat. The sun provides radiant energy to the earth that turns to thermal energy as it is absorbed by objects. People and other animals give off thermal energy as they metabolize. That's why children become flushed and warm after running around — their metabolisms are revved up!

Children can test the heat energy of the sun on a sunny day with this experiment. Fill four paper cups as follows:

1. cup one *soil*
2. cup two *sand*
3. cup three *tap water*
4. cup four *popped popcorn*

Let cups sit until contents reach room temperature. Then cluster them outside. Let children quickly feel the contents to note that the temperatures are very close for all cups. Leave the cups outside in the sun for one hour. Let children feel the contents again. Which is the hottest? The coolest? Let children take a vote. Move all the cups inside to a cool, dark place. Let participants check the temperatures every 10 minutes or so. Which cup cools down the fastest? *(Popcorn.)* Which cools down the least? *(Water).* Which medium is best at storing heat? *(Water.)*

Adaptation

Let children devise experiments to test the various types of energy. For example they may choose to roll a snowball down a hill to test mechanical energy. Or they may heat substances other than water with the sun's energy. Encourage their explorations.

Evaluating Progress

What is energy? How can you get energy? What is the main source of energy to the earth? How do plants use energy? How do people use energy?

Fair Game

The sun provides the earth with most of its energy. Draw a poster showing the things that the sun does for the earth. Show what we can do because of the sun. Cut pictures from magazines or draw them yourself.

One for All and All for One

Children can write a song about energy and perform it in front of other people. Here's an example, written to the tune of "Row, Row, Row Your Boat."

Child, child, puts on her coat
Using energy!
Out she goes to play and run
Laughing merrily!

Child, child ate some lunch
Peanut butter yum!
Now she jumps and skips and flips
Energy is fun!

ACTIVITY 1.2

POLE BEAN RACES

Ages: 5 to 12

Style: adult or teen led

Life Skills: trying new things; building a base of experiences; working together cooperatively; developing intellectual curiosity; predicting outcomes of situations; refining small motor skills

Pre-Activities: 1.1

Time Needed: 45 minutes originally; up to two weeks for observation

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: chalkboard and chalk or flip chart and markers, pole bean seeds, soil, small paper cups, shoe boxes, extra cardboard, scissors, water, glue or tape

To demonstrate that the sun provides energy to the earth.

Preview

Children discuss where they get the food they eat and how plants make this food. They plant pole beans in a cup and let their plants race through a maze.

How to Do the Activity

Review the concept of energy with participants. Energy is simply the ability to do work. We go to the gas station and fill our cars with energy in the form of gasoline. We flip on a switch and send electrical energy to the light in our room. If we run out of energy, we feel hungry and eat . . .what? Gasoline? Coal? No! Food! But where does the energy in our food come from? It comes from the sun.

Ask participants what they had for lunch. Make a list on a flip chart or chalkboard. Now trace the items back to plant material. Your list may look like this:

peanut butter sandwich] → *wheat bread from wheat plants peanuts from plants, oil from corn, sugar from sugar beets*

applesauce] → *apples from apple tree*

milk] → *cows that eat hay*

Explain to participants that all these plants got their energy from the sun. All plants have factories in their leaves that make food. These leaf factories use water from their roots, carbon dioxide from the air, and energy from sunlight to make a sugar to feed themselves.

Divide participants into teams of two. Explain that they will be testing to see if plants really need the sun. Explain that you will be racing plants! Give each team a shoe box with lid, pole beans, and a cup full of soil. Let each team cut a small square out of one narrow end of the shoe box. Next, teams should cut long and short strips from the pieces they removed (and from extra cardboard) and glue or tape them to the inside of the boxes to make a maze.

Now instruct teams to plant their pole beans in the cups and water lightly. Each team should then stand the box with the hole up on end, put the plant in the box, and put the lid on the box. Teams should place their boxes where light can penetrate the opening (outside in warm weather works best). The only light getting to the plant should be from the top.

POLE BEAN RACES

Let teams check their pole beans after five or six days. Have they germinated? Are they growing? Teams should continue to observe and water (if necessary) their beans over the next several days. Did any of the beans find their way out of the box? Why didn't the beans just stay in the box? There was plenty of room to grow!

Evaluating Progress

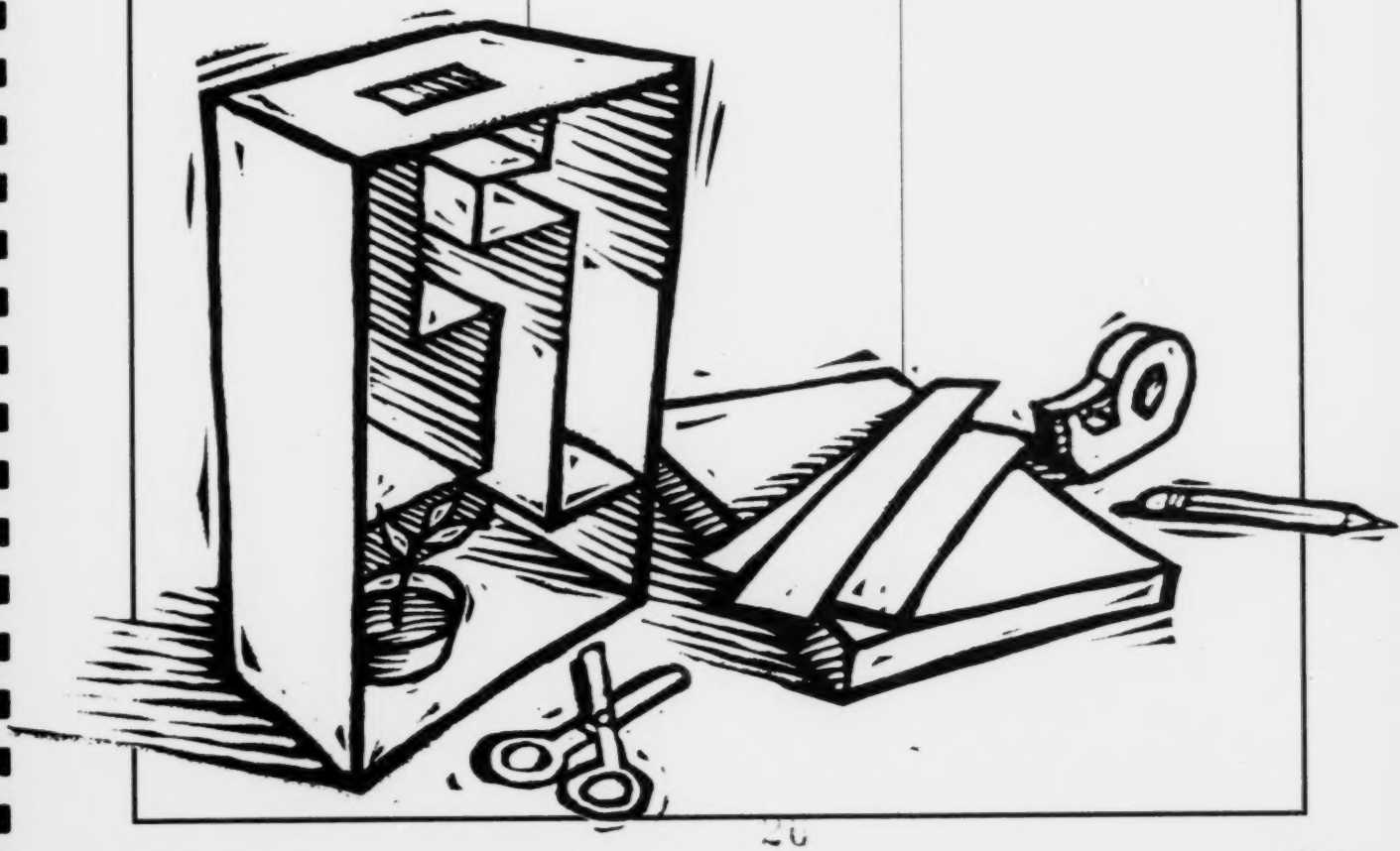
What is energy? What do plants use to make food energy? (Sunlight, carbon dioxide, and water.) Do plants store energy? (Yes — in their roots and other tissues.) Why do plants need sunlight? (To energize their leaf factories.)

Fair Game

Think about other mazes you could make. Try different plants and different mazes, or cut different sizes of openings in your shoe box. Compare your plants and mazes to each other. Which climb the fastest? Which plants get to the top the fastest? Does the size of the hole make a difference? Graph the results of your trials on a poster and explain your experiment.

One for All and All for One

Have a leaf-factory tasting party! You'll need sour cream or plain yogurt, crackers, scissors, mixing spoons, and napkins. Have parents or other adults bring their favorite herbs (mint, dill, chives, etc.) to your party. Children should explain to guests how plants make food using the sun. Then have adults help children cut up the herbs with scissors and mix each into a different container of sour cream or yogurt. (You'll need about one cup sour cream or yogurt for each two tablespoons of herbs.) Spread the mixtures on crackers and serve to your guests. Ask them which leaf factory they like the best!



ACTIVITY 1.3

ENERGY DIARIES

Ages: 5 to 12

Style: adult or teen led

Life Skills: trying new things; building a base of experience; learning by using the five senses; developing intellectual curiosity; refining small motor skills

Pre-Activities: 1.1, 1.2

Time Needed: 25 minutes originally; one week at home; 20 minutes process time

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of Activity Sheet 1.3A, scarves, samples of orange and banana, clean sheet of paper, cookie. (Note: it's important that the leaf is from a non-poisonous tree species, such as maple or aspen. If you are unsure of tree identification, use another common object, such as a pencil or eraser.)

To understand food provides energy.

Preview

Children learn how food provides energy, then determine, using smell or taste, whether an item can be used as fuel (food) by humans. They also keep an energy diary for a week.

How to Do the Activity

Before you begin the activity, prepare the foods, blindfold, and other materials described in the materials list.

Reinforce that food provides chemical energy (see Activities 1.1 and 1.2). Without energy, we would not be able to run, jump, skip, hop, or slide. Ask participants to name some of their favorite sources of energy (bananas, cookies, etc.).

Now ask participants if they can identify sources of energy by taste or smell. Blindfold two volunteers. Explain that these brave volunteers will try to determine by taste or smell whether something can be used as energy by humans. Choose one of your volunteers to be the taster, and the other the sniffer. (Make sure that your volunteers are willing participants. If they would rather not participate, replace them with other volunteers.)

Bring out the items described in the materials list. Hold one up, and ask loudly "Would you eat this to get energy?" Hold the item under the nose of the sniffer. Let him or her answer. Next, offer a small piece to the taster. Ask again, "Would you eat this to get energy?" The taster can lick or chew a small portion to determine if it is food. (You can record their responses on a chalkboard or flip chart.) Repeat until you have tested all of the items. Remove blindfolds from participants.

Explain to the group that it is very important to energize every day. Food provides fuel to bodies. Some items, such as wood or tree leaves, generally can't be used as fuel by humans. But other animals may use these items as fuel.

Ask the children to find out what types of things they eat to energize! Hand out copies of Activity Sheet 1.3A. Let the children keep an energy diary for a week (or a few days, if you prefer.) They can write the name of the item they've eaten or draw its picture, getting reading help from an older person at home as needed. Children will subjectively determine which foods give the most energy (but see Adaptation, below.)

ENERGY DIARIES

After they have completed their energy diaries, let the children share some of the things they have recorded. Discuss their responses. What types of food give the most energy? The least? What kinds of food would really energize them?

You may wish to distribute copies of the food pyramid and discuss it with participants. The food pyramid shows the type of foods we need for energy, vitamins, and minerals.

Adaptation

Older children (ages eight to 12) may wish to compute the amount of energy in the food they consume. They can use books with calorie counts to calculate the amount of energy they consume each day. Some of the amounts may be truly astounding!

Evaluating Progress

Name some things we use for energy. How does food provide energy? (Our bodies break down — metabolize — the food, releasing chemical energy.) Can we eat anything as food? (No — our bodies can't use pencils, erasers, and other nonfood items for energy. You can't put water in an automobile tank, nor can you put gas in people and expect them to go!)

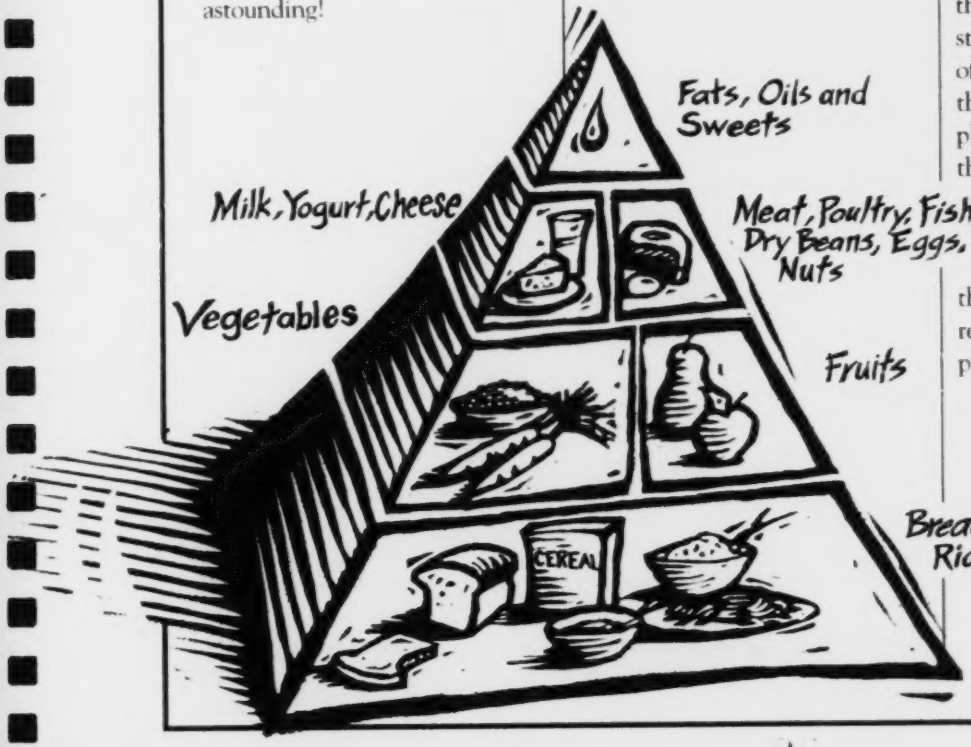
Fair Game

It takes energy to make food energy. Raising animals or crops for food takes lots of energy. Animals are sometimes fed grain. The grain uses solar energy to grow, and it took fossil fuel energy to plant, harvest, and transport it. Vegetables and fruits gain energy from the sun and are planted, harvested, and transported using energy. It also takes energy to process foods into a form for selling at the supermarket. The bacon and eggs you eat at breakfast took a lot of energy to get to your plate!

Try to list or draw all of the energy needed to make a meal. Start with growing the vegetables and fruits. List energy needed to feed, water, or raise meat. Make a poster or three-sided display of your findings. Were you surprised at the amount of energy required to feed one person a single meal?

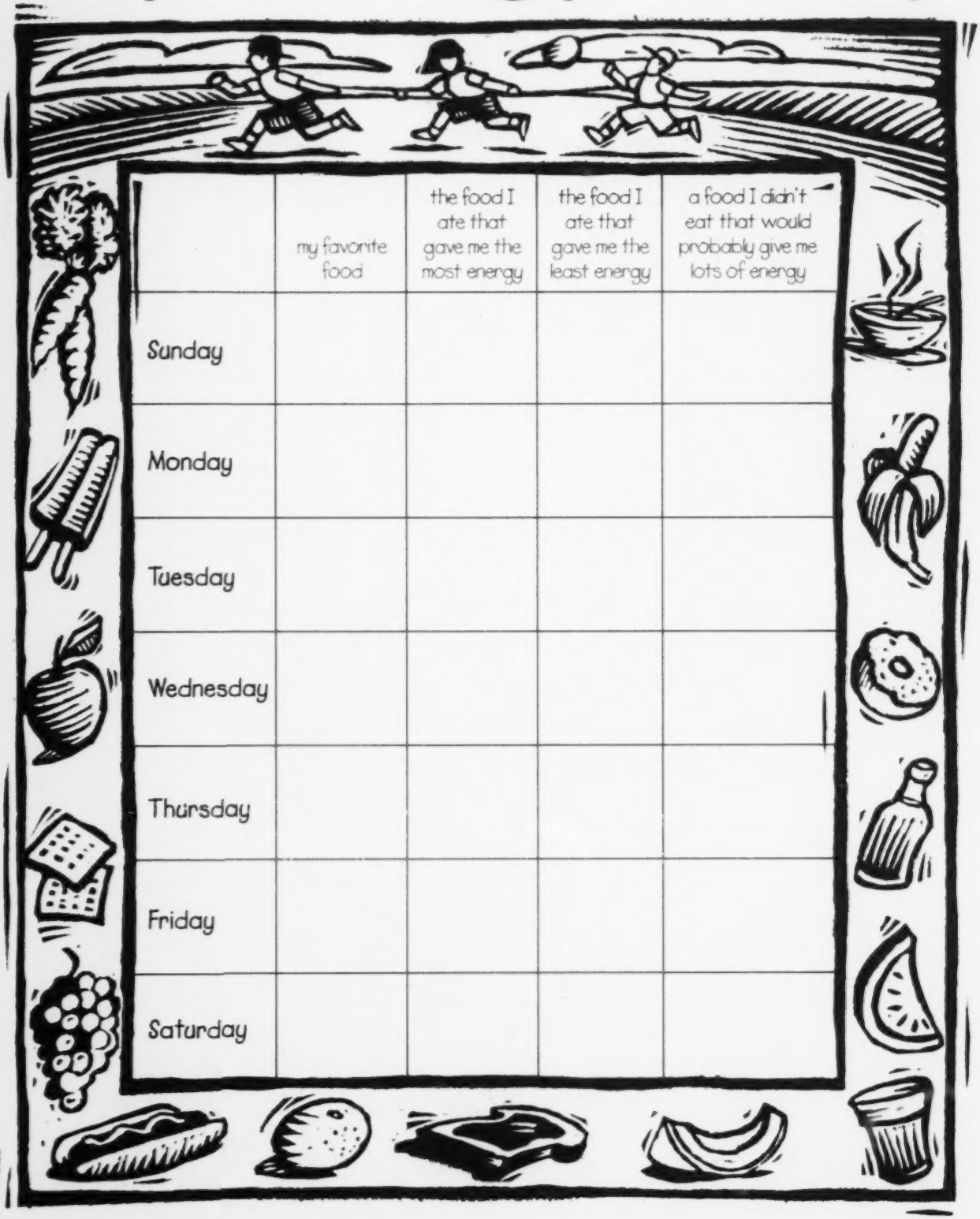
One for All and All for One

Grow some group energy! Have participants vote on their favorite vegetable that will grow in your area. Get a large pot or other container with holes at the bottom to drain water, sterilized potting soil, and seeds of the winning vegetable. Put the soil in the container and plant the seeds. Gently water the soil. Put your container outside in full sunlight, and wait for your delicious crop to come up. If you are doing this during cold weather, fluorescent lights will enable your plants to grow.



ACTIVITY SHEET 1.3A

My Energy Diary



	my favorite food	the food I ate that gave me the most energy	the food I ate that gave me the least energy	a food I didn't eat that would probably give me lots of energy
Sunday				
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				

ACTIVITY 1.4

BLUE BOAT TAKES A RIDE

Ages: 5 to 12

Style: adult or teen led

Life Skills: building a base of experience; expressing creativity; practicing problem solving; developing intellectual curiosity; identifying resources; refining small motor skills

Pre-Activities: 1.1, 1.2, 1.3

Time Needed: 45 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: art paper; crayons, markers, or colored pencils

To explore different sources of energy.

Preview

Participants will design boats that use different fuel sources.

How to Do the Activity

Begin by asking children to name some things that provide energy. Young children may erroneously name things that use energy (e.g., computers, televisions, and lights). You may have to prompt them to get a list of energy sources. For example, you may ask them "Well, what do you use for energy?" or "Have you ever built a fire? What did you use for fuel?" Write their lists of energy on a chalkboard or flip chart. The list might look like this:

- wood
- sunlight
- gasoline
- food
- wind
- batteries

Review this list with participants. With young children, you may want to use a rhyme to help them remember the responses. For example:

The **wind** *blows my hair*
Through the air

Wood *in the fire*
Makes the flames go higher

A **corn dog** *on a stick*
Makes me run and jump and kick

Now ask the children to close their eyes and tilt their heads forward. Ask them to imagine the following:

You are walking on a long dock with your best friend. At the end of the dock is a boat. It's just big enough for you and a friend. The boat is painted a shiny white with sky blue trim. It's tied to the dock, but the waves are rocking the little boat. You want to get on the boat with your friend and go to an island you can see from the dock. The island has tall palm trees with coconuts and lots of shells on the beach. But you're not sure how to get the boat over to the island.

Ask participants to open their eyes. Give each child a piece of paper and some markers, crayons, or colored pencils. Explain that they will be designing a fuel source for the boat so they can take the trip over to the island. Encourage them to consider some of the fuels from your list (not just focusing on the obvious — gasoline — as a fuel). Tell them to turn their imaginations loose to create the perfect boat!

Optional: Assign different fuels (e.g., sunlight, wood) from your list to teams of children. This will ensure that boats use something other than the obvious choices — wind and fossil fuels — as fuel.

Give children several minutes to design their boats. After they have finished, let them show and explain their inventions to the rest of the group. Ask each child:

1. What is the fuel for your boat?

2. Do you think you could really build a boat like this?

3. Would the fuel be hard to get? Is it always available?

Congratulate all designers on their creations. Display the pictures around the room.

Adaptation

Older children can test their inventions. Supply a pond (or large tub of water), balsa, and other supplies as requested by participants. Or challenge them to build the boats on their own and demonstrate them to the rest of the group at a "Sail Off."

Evaluating Progress

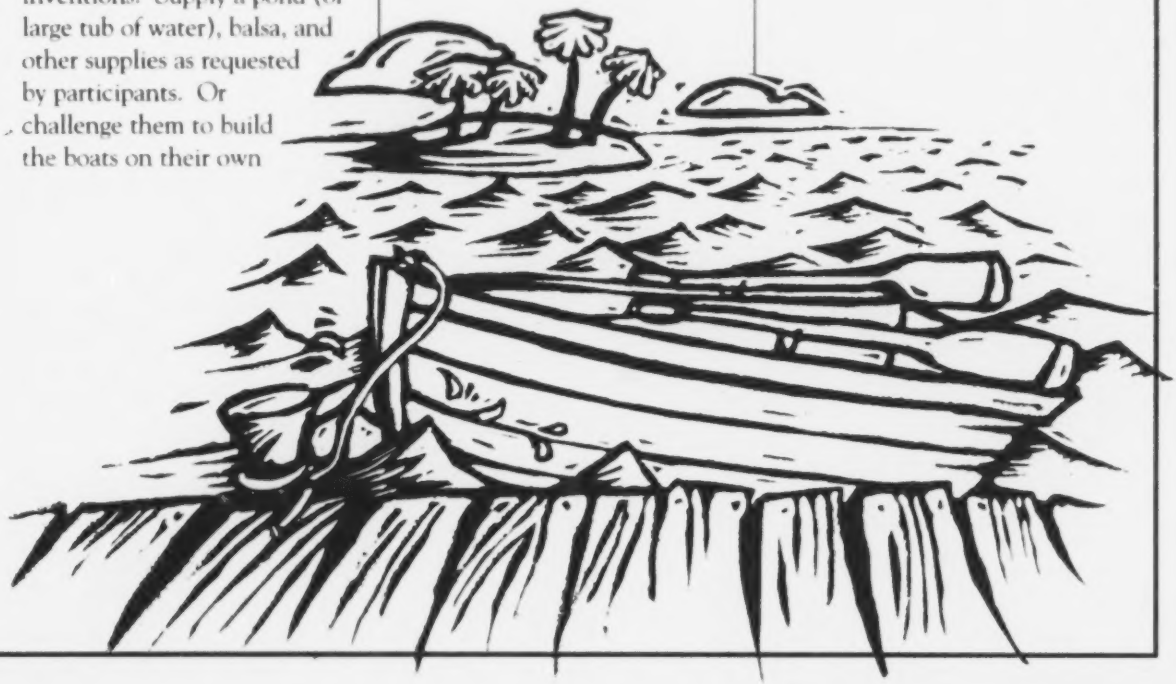
Name some sources of energy. Which are provided freely in the environment? (Sun, wind, moving water.) Which need to be removed or harvested before we can use them? (Fossil fuels, biomass.) Why don't we just use the "free" sources of energy to run boats and other things? (Because it often takes things that aren't "free" to make wind, water, and sun available as energy sources. For example, we must build dams to generate electricity from water. We need solar collectors or batteries to capture and convert sun energy. The "free" sources also may not be available where they are needed, when they are needed, or in the quantity desired.) Do we depend on energy to help us get where we are going? (Yes!)

Fair Game

Create a three-panel display or poster showing different types of energy sources and how we use them. Do they make cars go? Do they heat homes? Do they fuel bodies? Cut pictures from magazines of different things using energy and put them on your poster or display.

One for All and All for One

Plan as a group to swap fossil fuels for food energy! The next time you need to get to your meeting or class, walk, bike, or skate! Sweep the stairs instead of vacuuming. Shovel snow instead of using a snowblower. See how many "sweat hours" your group can accumulate in a week. Do you find that you're eating more because of the extra work you're doing? (Remember it takes energy to grow, move, and cook food!)



Chapter 2

Energy Sources

Fossils as Fuels. Millions of years ago, arthropods, bony fish, wormlike animals, and prehistoric plants settled to the bottom of ancient seas. They mixed with mud and silt. Eventually, as the earth heaved and buckled and changed, enough pressure and heat were generated to change these primordial remains into compounds of hydrogen and carbon, forming the fossil fuels we use today. Fossil fuels are essentially trapped sunshine.

Natural gas, oil, and coal[3] are fossil fuels. We extract these fossil fuels to drive our lives. Industries and homes burn these fossil remains of prehistoric life. Manufacturers turn them into medicines, mud boots, and milk jugs. Automobiles use them to go.

Other Sources of Energy

For centuries people harnessed the wind to pump water, run machinery, and generate electricity. Wind actually is a form of solar energy — it is created as the earth heats and cools each day. Today many countries use the energy captured by large wind farms to generate electricity. In the United States, enough wind is harnessed each year to provide the electricity needs of 300,000 households.[4]

Other sources of energy also fuel our lives. Electricity is generated from nuclear energy when atoms of uranium or plutonium are split apart. Nuclear energy is a major fuel source in France, Sweden, India, and Belgium. In the United States, nuclear energy provides less than one-fourth of our electricity.

Biomass fuels include anything organic, such as trees, plant residue, and animal droppings. Biomass supplies about 14 percent of the world's primary energy.[5] It is an essential fuel in developing countries, especially in rural areas, where it generates about 90 percent of the energy used for heating and cooking. In the United States, only about 3.2 percent of all the energy we use comes from biomass.

Old Faithful in Yellowstone Park is an example of geothermal energy. Heat from the core of the earth can be converted to electricity or used directly for heat.

Hydropower is generated when energy released as water drops from one elevation to another and is converted to electricity or harvested directly. In many parts of the United States, dams have been built to store water and generate electricity. Washington and Oregon are two states that depend on the energy of their rivers to light up their cafes and homes.

The most important source of energy in the world is the sun. On cold winter days when you sit in a sunny spot to read a book, you're using solar energy for added warmth. We can capture solar energy to heat homes or water or even to generate electricity.

Measuring Energy

How can we compare energy sources? Energy is measured by the amount of heat it contains. The most common unit of measurement is called the British thermal unit, or Btu. One Btu equals the amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit. A wooden

[3] Coal was created from plant remains from ancient marshes. It does not include animal remains.

[4] National Energy Education Development Project, *Elementary/Middle School Energy Fact Sheets* (Reston, VA: 1995).

[5] United National Environment Programme, *Environmental Data Report 1993-94* (Washington DC: World Resources Institute, 1994).

match burned entirely gives off about one Btu of energy.

The Price We Pay

Fossil fuels such as natural gas and oil are not available in unlimited quantities. They are *scarce* relative to our present and future demands. This is why it costs money to fill your car tank with gasoline and heat your home. If these natural resources weren't scarce, we would not have to "ration" them with prices.

Some forms of energy, such as wind and solar, are plentiful; indeed the supply seems endless. However, we still pay for electricity they generate. Why? Because the process of converting these resources to electricity requires both labor and costly equipment.

It Takes Energy to Generate Energy

Energy production is really energy conversion, not energy creation. Every energy conversion involves some energy loss to an uncapturable form (e.g., heat). Basically, this means you can never end up with as much usable energy as you started with.

Some fuel sources provide a better return on investment for generating electricity than others. For example, it takes less fuel inputs to generate hydroelectricity than to make electricity from coal.

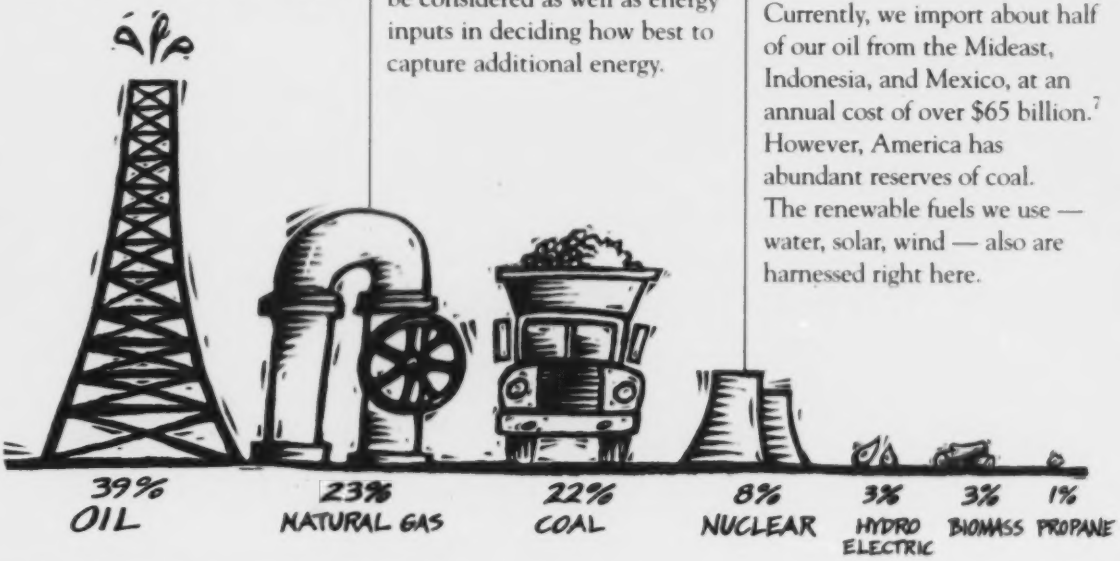
This makes perfect sense when you think of the energy input required to harvest and transport coal as compared to the potential energy in water lifted by the sun into the mountains. However, keep in mind that building dams to generate hydroelectric energy also uses a considerable amount of other inputs such as concrete, steel, machinery, and labor, and influences land use and aesthetics. These many variables should be considered as well as energy inputs in deciding how best to capture additional energy.

States that extract and refine fossil fuels, such as Alaska, Louisiana, and Wyoming, usually have high per capita rates of energy use. This is because energy is used to mine and refine fossil fuels.

U.S. Energy Sources

Where does the United States get the energy it needs to build bridges, open doors, take the high roads, and do all the other things we do? Most of the 88.5 quads (quadrillion Btus of energy) we use each year comes from fossil fuels. About 39 percent of our energy needs are met by oil. Natural gas helps us meet about 23 percent of our energy needs, while coal provides 22 percent. Nuclear energy accounts for about 8 percent of our energy consumption, and hydroelectricity provides about 3 percent. Biomass gives us about 3 percent of the energy we use, while propane yields about 1 percent.[6]

Currently, we import about half of our oil from the Mideast, Indonesia, and Mexico, at an annual cost of over $65 billion.[7] However, America has abundant reserves of coal. The renewable fuels we use — water, solar, wind — also are harnessed right here.



[6] Energy Information Administration, *1994 Energy Facts*.
[7] David Pimentel and others, "Renewable Energy: Economic and Environmental Issues" (BioScience 44:8).

ACTIVITY 2.1

BETWEEN A ROCK AND A HARD PLACE

Ages: 9 to 18

Style: adult or teen led

Life Skills: asking incisive questions; understanding scientific and technological ideas; working on a team; organizing groups to accomplish a purpose; asking questions to get information

Pre-Activities: 1.1, 2.1, 2.2

Time Needed: two to four hours

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of Activity Sheet 2.3A cut into cards, other materials as suggested

ACTIVITY GOALS

To discover different technologies used to capture and extract energy resources.

Preview

Working in teams, participants select a type of energy resource. They investigate how it is extracted or harvested and share their information and working models with the rest of the group.

How to Do the Activity

Ask participants to name some sources of energy. Their responses should include fossil fuels, wood, food, sunlight, and moving water. Now ask if they know how we extract or capture them.

Divide participants into teams of two or three. Give each (or let each pick) a card from Activity Sheet 2.1A. Explain that each card gives an energy source and some information about how that energy is extracted or captured. Give teams a few minutes to read the cards and ask questions. Don't worry if you can't answer all of their questions — they will be using other resources to find information.

Explain that each team will make a model to show how their energy source is captured or extracted. For example, if they've chosen coal, they may want to build a model showing surface or underground mining.

Provide plenty of resources and art supplies for each group (or let them complete the project at home using common materials). Some things you may want to have on hand:

- rocks
- wiremarkers
- moss
- tinfoil
- wood chips
- toothpicks
- glue
- styrofoam
- beans
- water
- molasses
- marshmallows
- paint
- straws
- soil
- string
- papier-mâché

Give teams a few hours to design and build their models. After they are done, let each give a short presentation. Let the group ask questions about how the resource is mined or collected. Ask teams: What are the environmental impacts of using or extracting this energy source? What resources (inputs) are used in the extraction process? How costly are they? Is the energy source renewable or nonrenewable? If renewable, are any nonrenewable items used to convert, store, or transport the energy?

Evaluating Progress
Name six sources of energy. Briefly describe how they are captured or mined. (See cards.)

Fair Game
Your model can serve as an excellent entry into a county, state, or science fair. Complete a written report and poster to describe the energy source. Does the United States have much of this resource? Do we bring it in from other countries (or outer space)? Share any information you have about your energy source.

One for All and All for One
Biomass is sometimes used to heat homes. Fireplaces and woodstoves burn wood to heat rooms and sometimes entire houses. If they are not properly maintained, a chemical called creosote can build up and cause a fire. If you live in an area where wood is used to heat homes, consider sponsoring a Fuel Wood Safety Night. Invite parents and community residents. Line up speakers, including chimney cleaners and fuel wood specialists (foresters) from your local department of natural resources. Learn to use wood safely!

Between a Rock and a Hard Place

ACTIVITY SHEET 2.1A

Natural Gas

Natural gas is a fossil fuel. It's usually found hundreds of feet underground trapped in rocks. Natural gas is captured from below the surface of the earth and transported by pipeline around the country. The United States has more than one million miles of pipeline under the ground, transporting natural gas!

Wind

Wind is caused by the heating and the cooling of the earth. People have been using wind energy for centuries. Wind made long sea voyages possible, and helped early settlers grind wheat and pump water. Today's wind machines often are used to generate electricity. Large blades turn a shaft connected to a turbine that generates electricity.

Geothermal

Geothermal energy is found under the earth's surface. It's available when the heat from the core of the earth comes close to the earth's surface. To tap into these resources, wells are drilled into the ground, and typically water is used to bring the heat to the surface. Geothermal energy is found mostly where there are a lot of earthquakes (e.g., Japan or California).

New Invented Energy

What other things could be used for energy? The waves of the sea? Empty juice boxes? Suggest a form of energy and a way to capture or mine that source.

Note. Empty juice boxes are biomass, and harnessing waves is hydropower. But use your imagination!

Oil

Oil is a fossil fuel found in underground deposits. We use wells to mine oil from the rocks where they are found. A well is drilled and then the oil is pumped to the surface. It may be as thin and watery as gasoline or as thick as molasses.

Nuclear Fission

Nuclear energy is released when an atom is split in the process called fission. During fission, a heavy atom is split into lighter atoms, the total mass of which is less than the original atom. The missing mass is converted to energy.

Solar

Solar energy comes from the sun. There are many different ways to capture the energy of the sun. A solar collector gathers sun energy and converts it to heat. Solar ponds are sometimes used to capture and store solar radiation. Ponds are lined with salt that helps trap heat. Solar energy also is used to generate electricity.

Hydropower

Hydropower is harvested by capturing the energy in moving water. Gravity gives water its energy. A dam is built on a river, forming a reservoir of water that can be stored for long periods of time. An electric plant at the dam captures the energy of water flowing from the reservoir and turns it into electricity. Hydropower was once used to run flour and cider mills. A wheel with buckets of water attached would be turned by the falling water. This movement in turn caused another wheel to spin, grinding wheat to make flour.

Coal

Coal is mined either from the surface of the earth or from underground. During surface mining, heavy equipment moves rocks and soil to expose coal down to about 200 feet below the ground. When the mining is finished, the land is often reclaimed. Soil, grasses, and other vegetation are replaced. In underground mining, coal is removed from more than 200 feet below the earth's surface. Deep shafts are built to give humans and machines access to the coal.

Biomass

Biomass is mined by cutting down trees or by collecting crops and other organic materials, including trash. (Of course, the plastics in the trash are fossil-fuel based!) These materials are burned to generate electricity. They also can be used to produce ethanol, a biomass-based liquid fuel.

ACTIVITY 2.2

A DIP IN THE POOL

Ages: 9 to 18

Style: adult or teen led

Life Skills: listening to others; expressing an opinion; speaking and writing persuasively; understanding scientific and technological ideas; developing intellectual curiosity; identifying problems; comparing and selecting alternatives; thinking about the future; anticipating change

Pre-Activities: 1.1, 2.1

Time Needed: 45 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: chalkboard and chalk or flip chart and markers, paper and pencils

To define and give examples of renewable and non-renewable sources of energy.

Preview

Participants decide whether certain energy sources are renewable or nonrenewable. They take a dip in the Brainwriting Pool to generate solutions to energy dilemmas.

How to Do the Activity

Define the terms renewable and nonrenewable for participants. Renewable resources are those that can be grown again in a lifetime or can be used without permanently depleting the resources. Nonrenewable resources cannot be made again in that time span. A tree is considered a renewable resource, since it can grow to maturity in 70 to 80 years (depending on the species). Gold is a nonrenewable resource, since humans cannot create it and it is depletable.

Write *renewable* and *nonrenewable* on a chalkboard or flip chart. At the side, list the following sources of energy:

- natural gas
- hydropower
- coal
- nuclear
- oil
- propane
- biomass
- wind
- geothermal
- solar

Let participants assign these sources to one of the two categories. Remember, the key is the time it takes to re-create or regrow the resource. For example, fossil fuels such as oil could conceivably be re-created within the earth, but it would take many, many millions of years.

Answers and explanations to the categories are found under "Evaluating Progress" below. Discuss the answers with participants.

Next, introduce the *Brainwriting Pool* to participants.

This technique is relatively simple; the only interaction among group participants is in exchanging pieces of paper from a "pool" located in the center of the table. A problem is presented to the group and recorded on a flip chart. Participants silently write down their ideas on a sheet of paper. As soon as a person has listed four ideas, they place the sheet of paper in the "pool" at the center of the table, exchanging it for another sheet. Participants then add ideas to the sheet they have taken and return it to the "pool" to exchange for another sheet.[8]

Give participants paper and pencils. Pose the following dilemma to the group:

[8] Susan Halbert and Jean Hovey, *Building Common Ground: Planning for Change* (Washington, DC: National 4-H Council, 1994).

Our reserves of oil are becoming more and more scarce. Eventually, oil will either be used up or be too expensive for most people to afford. What will we do when that time comes?

Give individuals several minutes to brainwrite. After they have finished, read the responses and discuss solutions. Here are some possible responses the group might generate:

1. Increase our exploration and discover more oil.

2. Conserve — use less energy.

3. Substitute other energy sources for oil.

Remember that the high price is not the problem. The problem is the growing scarcity of oil. The higher price reflects this and then sets in motion the actions to deal with this rising scarcity.

Evaluating Progress

What is the difference between renewable and nonrenewable resources? (Renewable resources can be regrown in a lifetime or used without depleting the resources. Nonrenewable resources can't.) What are the advantages of each? (Renewable resources can be remade for many generations as long as the things they need to grow aren't finite. Nonrenewable resources may be cheap to use or harvest.) The disadvantages of each? (Renewable resources may be expensive to use, or their harvest and use may damage the environment. Nonrenewable resources will, of course, become increasingly scarce, since no more can be made.)

Answers to flip chart/chalkboard items:

natural gas: *nonrenewable*. Natural gas is a fossil fuel.

nuclear: *nonrenewable*. Our nuclear energy sources come from uranium, a common but nonrenewable element.

biomass: *renewable*. Biomass includes wood, crop residue, and other organic material that can be grown.

geothermal: *renewable*. Geothermal energy is heat from the earth's core. It is considered renewable because heat within the core is constantly available. Although the heat cannot be re-created it is considered inexhaustible. However, the underground water that is heated by geothermal energy can be depleted (converted to other bodies of water above the earth's surface or in different underground locations).

hydropower: *renewable*. Rivers are replenished by precipitation.

oil: *nonrenewable*. Oil is a fossil fuel.

wind: *renewable*. The sunlight that warms the earth, producing wind, is considered inexhaustible.

solar: *renewable*.

coal: *nonrenewable*. Coal is a fossil fuel.

propane: *nonrenewable*. Propane is a fossil fuel.

It's important to note that even though some of these fuels (e.g., biomass) are renewable, they currently rely on nonrenewable fuels for extraction, harvest, or transport. This does not have to be the case. Vehicles and machinery can run on solar electricity, wood, alcohol, and other renewable fuels. It is possible to design a closed system. However, costs, institutional climates, and resource availability may render such systems unworkable, at least for now.

Fair Game

Create a display showing renewable and nonrenewable sources of energy. You might want to make it in the form of a game, in which people guess if a fuel is renewable or nonrenewable and lift up a small panel to see the answer.

One for All and All for One

A major reason to recycle an item is to reduce the amount of solid materials being placed in landfills. Items made from renewable and nonrenewable resources can be recycled. Recycling has benefits and costs. For example, plastic has to be picked up by trucks using fuels and transported to a collection site. It is sorted by hand or machine and transformed back into raw materials using energy. It is then remanufactured into a product using energy. Along the way, it has been transported between sites. The use of fuel, materials, and human labor is the cost. The benefit is that the plastic doesn't have to be produced from newly extracted raw materials (which may not be renewable) and it doesn't have to be managed as a waste. As a group project, chart the benefits and costs of recycling it.

ACTIVITY 2.3

FACT OR FOIL

Ages: 9 to 18

Style: adult or teen led

Life Skills: speaking persuasively; speaking before a group; understanding scientific and technological ideas

Pre-Activities: 1.1, 2.1, 2.2

Time Needed: 30 minutes

Group Size: any (10 to 20 preferred)

Indoors or Outdoors: indoors

Materials Needed: copy of Activity Sheet 2.3A cut into cards, paper bag

ACTIVITY GOALS

To know that energy is found in many forms.

Preview

Participants learn energy facts playing "Fact or Foil."

How to Do the Activity

Ask participants: What do we use to move our bodies and cars and run our homes and industries? We use energy! Energy is found in many forms. We harness many different types of energy to run our lives.

Put cut-up cards from Activity Sheet 2.3A into a paper bag. Seat participants in a circle. Explain the rules to Fact or Foil:

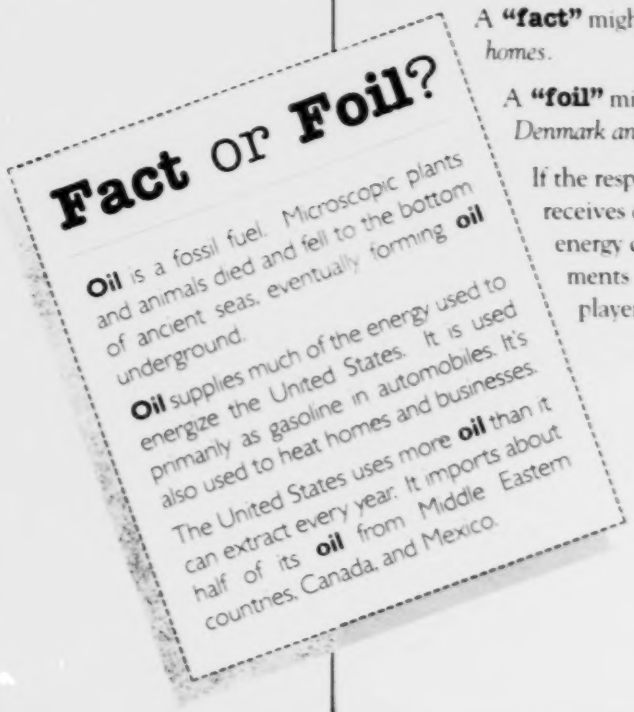
A participant draws a card from the bag. Using the bullet points on the text, the person gives clues until someone correctly guesses what type of energy is being described. (Respondents may raise their hands or use noisemakers — the first person volunteering should be called upon for an answer.)

The person who correctly guesses the energy source receives five points. He or she also gets to answer additional statement as "fact" or "foil." The person holding the energy card makes statements based on the energy card's information that the respondent deems to be true (fact) or false (foil). For example, under the solar card:

A **"fact"** might be: *Some people use solar energy to heat homes.*

A **"foil"** might be: *We import solar energy from Denmark and Australia.*

If the respondent answers correctly, he or she receives one point. If not, the person holding the energy card receives one point. Up to five statements can be made from each card. The other players may coach the respondent.


Fact or Foil?
Oil is a fossil fuel. Microscopic plants and animals died and fell to the bottom of ancient seas, eventually forming oil underground.
Oil supplies much of the energy used to energize the United States. It is used primarily as gasoline in automobiles. It's also used to heat homes and businesses.
The United States uses more oil than it can extract every year. It imports about half of its oil from Middle Eastern countries, Canada, and Mexico.

Play until all cards have been used. The person with the most points is the Energy Czar.

Adaptation
You may choose not to assign points and make the game less competitive.

Evaluating Progress
Name three energy sources. (Natural gas, nuclear, biomass, oil, etc.) Which source is usually used to run trucks and cars? (Mostly oil.) Name a source used to generate electricity. (Nuclear, coal, hydropower, wind, natural gas, biomass, and solar.) Which energy sources are fossil fuels? (Oil, coal, and natural gas.) Are there endless reserves (amounts) of any of these energy sources? (No. Some, such as fossil fuels, have a finite supply. Others, such as solar or biomass, are renewable and can be grown again or are inexhaustible. However, even renewable sources are limited by availability, cost of collection and conversion, and environmental impacts associated with their use. Later chapters describe how economics affect energy supplies in more detail.)

Fair Game
Find out what energy sources your state uses. Does it use coal to generate electricity? Oil to run cars? Do you live in a state with wind farms? Your local department of energy, transportation, or commerce can help you find information. Create a three-panel display on the energy sources used in your state!

One for All and All for One
Biomass can be many different things — wood, crop remains, peat, animal droppings, and more. Does biomass have a future as a fuel source in your area? Some states are planting hybrid poplars — fast-growing trees that can be harvested as fuel wood. Others already have many wood stove owners. Contact your local department of natural resources or conservation to see if there are any wood-for-energy projects that could use your group's help. Planting trees is always a good idea!

Fact or Foil?

Natural gas is a fossil fuel. It was formed millions of years ago when animals and plants died and decayed.

Natural gas is used to heat homes and businesses. It is used to manufacture goods. Natural gas also is used to generate electricity.

The United States extracts much of the **natural gas** it needs. Texas, Louisiana, and Wyoming provide **natural gas**.

3-1

ACTIVITY SHEET 2.3A

Energy Fact Cards

Fact or **Foil**?

Natural gas is a fossil fuel. It was formed millions of years ago when animals and plants died and decayed.

Natural gas is used to heat homes and businesses. It is used to manufacture goods. Natural gas also is used to generate electricity.

The United States extracts much of the **natural gas** it needs. Texas, Louisiana, and Wyoming provide **natural gas**.

Fact or **Foil**?

Nuclear energy comes from the splitting of uranium and plutonium.

Nuclear energy is used to generate electricity.

The United States doesn't import **nuclear energy**. There are more than 100 **nuclear energy** plants in the United States that generate electricity.

Fact or **Foil**?

Biomass is fuel made from organic material such as wood, animal droppings, cornstalks, and other material.

Biomass is used for heating homes, businesses, and industries.

The United States doesn't import any **biomass** to use as fuel.

Fact or **Foil**?

Coal is a fossil fuel formed from dead plants. It is found underground.

Coal is used to generate electricity. It's a major source of electricity in the United States.

The United States has large reserves of **coal**, so it exports some to other countries.

Fact or Foil?

Geothermal energy comes from heat within the earth.

Geothermal energy is used for heating and to generate electricity. In the United States, **geothermal** energy is used in California, Idaho, Nevada, Oregon, and Hawaii. France, New Zealand, and Iceland also capture geothermal energy to generate electricity.

The United States doesn't import or export **geothermal** energy.

Fact or Foil?

Hydropower is generated by moving water. Rivers have tremendous kinetic energy that can be harnessed. Waves and tides also are a source of **hydropower**.

Hydropower plants generate electricity. Washington and Oregon are two states that depend on electricity made by moving water. Wave and tidal energy is harnessed mostly in Europe. Japan and other island nations use **hydropower** extensively.

Fact or Foil?

Oil is a fossil fuel. Microscopic plants and animals died and fell to the bottom of ancient seas, eventually forming **oil** underground.

Oil supplies much of the energy used to energize the United States. It is used primarily as gasoline in automobiles. It's also used to heat homes and businesses.

The United States uses more **oil** than it can extract every year. It imports about half of its **oil** from Middle Eastern countries, Canada, and Mexico.

Fact or Foil?

Wind is moving air. It's caused by the heating of the earth's surface by the sun.

Wind can be captured to generate electricity. Less than 1 percent of all electricity in the United States is made from **wind**. Denmark and the Netherlands depend upon wind for much of their energy.

California uses more **wind** energy than any other area in the United States.

Fact or Foil?

Solar energy comes from the sun.

A PV, or photovoltaic, cell changes sunlight into electricity. Sunlight concentrated through mirrors also has been used to generate electricity. **Solar** energy can reduce the need for fossil fuels in heating homes.

Solar energy isn't imported from any country—it comes from outer space! However, copper and other resources used to capture and convert **solar** energy may be imported or exported.

Fact or Foil?

Propane is a fossil fuel. It is usually found underground with natural gas and oil.

Propane is used mostly for heating in homes, farms, and other businesses.

The United States produces most of the **propane** it uses. Less than 20 percent is imported.

ACTIVITY 2.4

ENERGY!

Ages: 13 to 18

Style: adult or teen led

Life Skills: expressing an opinion; understanding scientific and technological ideas; comparing and selecting alternatives; thinking globally

Pre-Activities: 2.1, 2.2, 2.3

Time Needed: 45 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of Activity Sheet 2.4A, one copy Activity Sheet 2.4B cut into cards

ACTIVITY GOALS

To examine U.S. sources and uses of energy.

Preview

Participants read and discuss information about energy use from Activity Sheet 2.4A. They play a game to see who can answer questions about energy supply and consumption.

How to Do the Activity

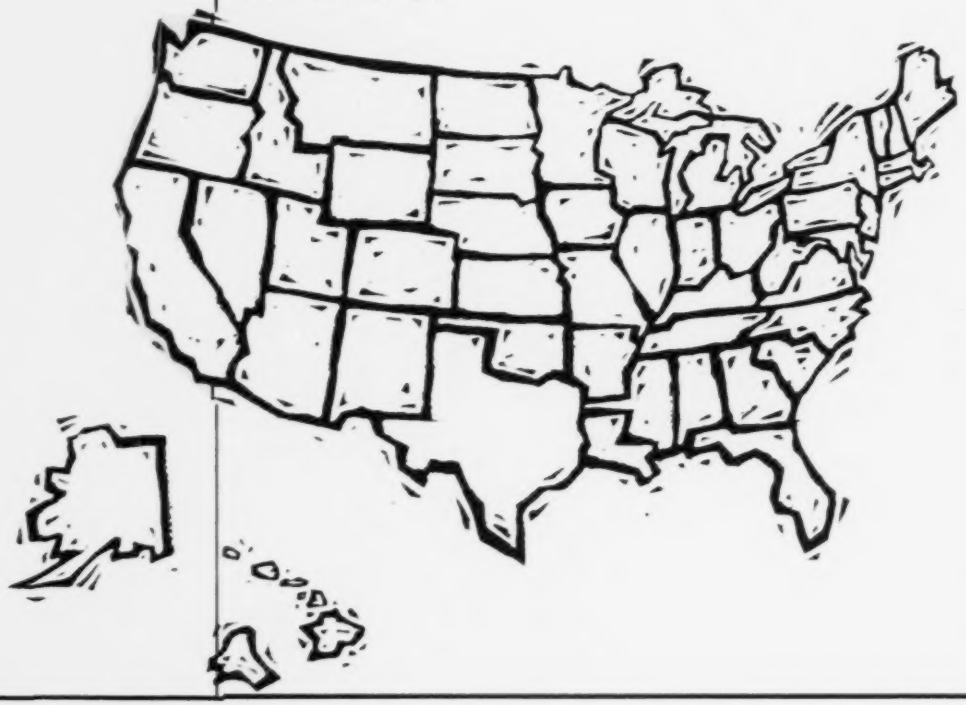
Hand out copies of Activity Sheet 2.4A. Discuss the information on the sheet. Use the following questions to help your discussion:

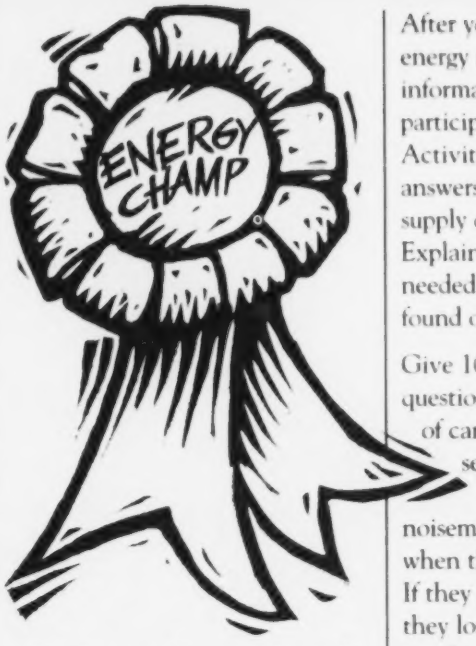
1. What does per capita mean? (Per person. The states with highest per capita use may not necessarily use the most total energy, just the most per person.)

2. Why do Alaskans use the most energy per person? (Raw material extraction is energy intensive. Most of Alaska's energy use can be attributed to industries extracting oil.)

3. Do states that rely heavily on extracting energy resources (coal, oil, etc.) tend to use more energy per capita? (Yes — look at West Virginia — coal, Alaska — oil, Texas — oil, Louisiana — oil, etc.)

4. Why does New York have low per capita energy needs? (It has a dense population, heavy reliance on mass transit in urban areas, and a high number of service and technology industries compared to manufacturing.)





5. What would energy be used for in each state? (Industry — producing goods; homes — heating, cooling, and general operation; commercial — heating, cooling, and general operation; transportation — moving people and goods.)

6. Do most states depend more on renewable or nonrenewable energy sources? (Nonrenewable.)

After you have discussed the energy supply and consumption information, play Energy! with participants. The cards on Activity Sheet 2.4B provide answers for which players must supply correct questions. Explain that many of the clues needed to provide questions are found on Activity Sheet 2.4A.

Give 10 points for right questions on the first round of cards, 20 points for the second round, and so on. Have participants use noisemakers or raise their hands when they know a question. If they give incorrect questions, they lose points equal to the number of the question. The person with the most points at the end is the Energy! Champ.

Evaluating Progress

How does your state rank in per capita energy consumption? Can you think of any reasons for its ranking? (Energy extraction activities, costs to transport fuel, extreme heating or cooling needs, etc.) What type of energy does your state use the most? What is this energy used for?

Fair Game

Investigate one state's energy consumption. You may wish to focus on a state with very high or very low energy consumption. Prepare a three-panel display or poster explaining your findings, and how this information affects you and your community. Maybe there are lessons to be learned from other regions!

One for All and All for One

Now that you know how your state measures up in energy use, help organize a community information campaign. Do some additional research about your state's energy consumption and sources of fuel. Utility companies and your state department of energy or commerce can help you. Books and almanacs also can provide valuable information about energy use. As part of your community campaign, you might want to produce a book or skit. Whatever your method, inform community members where they stand!

ACTIVITY SHEET 2.4A

ENERGY! TIP SHEET

How does your state rank? Below is a ranking of per capita energy use. Rural areas generally use more energy per capita than urban ones. States that extract natural gas, oil, and coal rank high in per capita energy use.

Annual Per Capita Energy Use and Primary Energy Sources[9]

State	Million Btus Per Capita Energy Use	Primary Energy	Population
1. Alaska	912	natural gas	570,000
2. Wyoming	820	coal	460,000
3. Louisiana	811	oil/natural gas	4,252,000
4. Texas	552	oil	17,349,000
5. North Dakota	490	coal	635,000
6. Indiana	442	coal	5,610,000
7. West Virginia	432	coal	1,801,000
8. Kansas	424	oil	2,495,000
9. Montana	413	coal	808,000
10. Oklahoma	403	natural gas	3,175,000
11. Alabama	377	coal	4,089,000
12. Kentucky	377	coal	3,713,000
13. Mississippi	362	oil	2,592,000
14. Washington	360	hydropower/oil	5,018,000
15. Tennessee	346	coal	4,953,000
16. Ohio	346	coal	10,939,000
17. Idaho	342	oil	1,039,000
18. New Mexico	339	coal	1,548,000
19. Delaware	338	oil	680,000
20. Iowa	337	oil	2,795,000
21. Nebraska	336	oil	1,593,000
22. Arkansas	333	oil	2,372,000
23. South Carolina	321	nuclear	3,560,000
24. Illinois	310	oil	11,543,000
25. Georgia	308	oil	6,623,000
26. Utah	302	coal	1,770,000
27. Maine	301	oil	1,235,000

[9] World Resources Institute, *The 1994 Information Please Environmental Almanac* (Boston: World Resources Institute, 1993), p 220, 230-279

ENERGY! TIP SHEET

State	Million Btus Per Capita Energy Use	Primary Energy	Population
28. Oregon	301	hydropower	2,922,000
29. Pennsylvania	301	coal	11,961,000
30. Minnesota	297	oil	4,432,000
31. New Jersey	295	oil	7,760,000
32. Michigan	294	oil	9,368,000
33. Missouri	293	oil	5,158,000
34. Virginia	293	oil	6,286,000
35. North Carolina	289	oil	6,737,000
36. South Dakota	289	oil	703,000
37. Wisconsin	281	oil	4,955,000
38. Nevada	276	coal	1,284,000
39. Colorado	267	oil	3,377,000
40. Maryland	255	oil	4,860,000
41. Arizona	239	oil	3,750,000
42. Hawaii	234	oil	1,135,000
43. Connecticut	230	oil	3,291,000
44. California	229	oil	30,380,000
45. Vermont	228	oil	567,000
46. Massachusetts	224	oil	5,996,000
47. Florida	221	oil	13,277,000
48. New Hampshire	220	oil	1,105,000
49. Rhode Island	215	oil	1,004,000
50. New York	199	oil	18,058,000

Energy! Cards

ACTIVITY SHEET 2.4B

The Wild West

A: This state is the biggest in the United States and also has the highest per capita rate of energy use.

Q: What is Alaska?

The Big City States

A: On average, the residents of this state each use a very small amount of energy, even though Times Square is always ablaze.

Q: What is New York?

State by State

A: These two states get much of their energy by harnessing the energy of rivers.

Q: What are Oregon and Washington?

Wild!

A: This tiny state, while a low per capita user of energy, depends almost completely upon imported oil to fuel its economy.

Q: What is Hawaii?

The Wild West

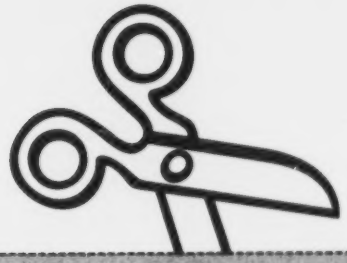
A: Almost half of this potato-growing state's energy comes from renewable resources, including water and geothermal.

Q: What is Idaho?

The Big City States

A: This state, despite the large number of air conditioners, boasts one of the lowest per capita energy uses in the nation.

Q: What is Florida?



State by State

A: This southern state is near the median for per capita energy use. However, it leads the nation in the percentage of electricity generated by nuclear energy.

Q: What is South Carolina?

Wild!

A: These two states border each other and rely heavily on water to generate electricity. Their annual per capita energy use, however, is 59 million Btus apart.

Q: What are Washington and Oregon?

The Wild West

A: This state is second only to Alaska in increase of energy use since 1973. Energy use in this state went up 60 percent in a twenty-year period, making it one of the top five states for per capita energy use in the nation.

Q: What is North Dakota?

The Big City States

A: This state's huge wind farms help provide renewable energy to its residents.

Q: What is California?

State by State

A: These three western states lead the country in use of renewable energy, harnessing water, wind, and biomass to meet their fuel needs.

Q: What are Washington, Oregon, and Idaho?

Wild!

A: More than half of this energy source is used to fuel cars, trucks, and trains.

Q: What is oil?

The Wild West

A: Sparsely populated states tend to have higher energy consumption per person. For example, rural school buses may travel many miles only half full, whereas in cities they would be laden with children. This least-populated state has a very high per person energy consumption.

Q: What is Wyoming?

The Big City States

A: The Windy City in this state depends upon oil.

Q: What is Illinois?

State by State

A: These two Lake State neighbors average four to five million people in population, and both rely on oil to get them through their cold winters.

Q: What are Minnesota and Wisconsin?

Wild!

A: These three states generate quite a bit of energy from resources such as oil and coal. As a result, their average use of energy per person is very high.

Q: What are Louisiana, Texas, and West Virginia?

Chapter 3

Wild Energy

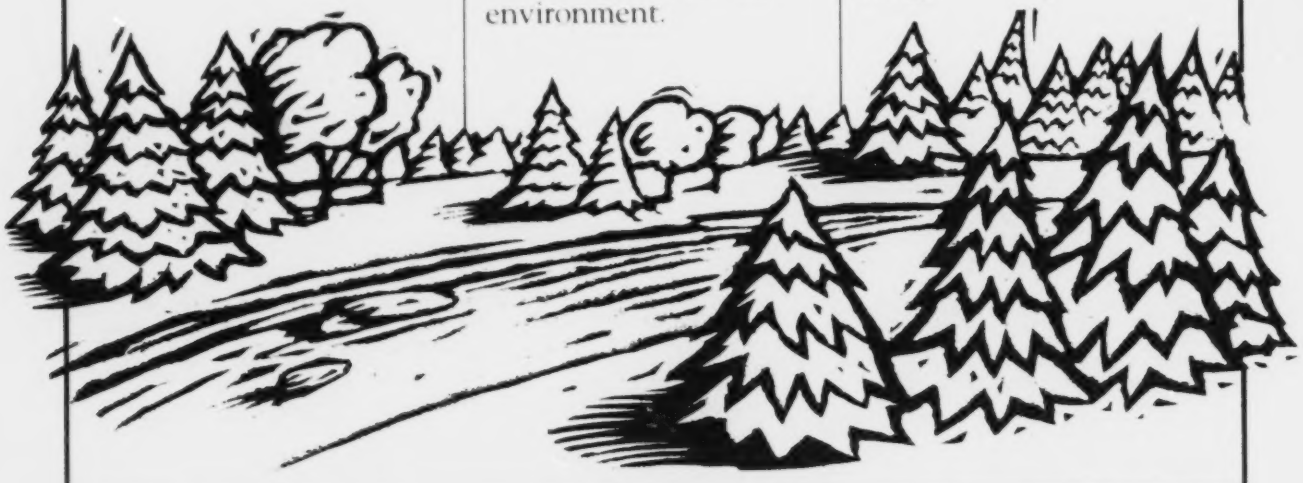
Natural Resource Supply and Demand. We use natural resources, including energy resources, to produce things we use every day. Our clothes come from fluffy cotton, from animals grazing green meadows, or from oil. Even televisions, crayons, balloons, and fishing rods are made from natural resources — in this case, primarily oil.

Natural resources don't just provide us with raw materials to produce goods and services — they also have direct value. For example, a forest can be harvested to produce paper and furniture, but it also can be left to provide habitat or scenery, absorb carbon dioxide, or simply comfort us with the knowledge that part of nature is left preserved. Some of the uses are trade-offs — one comes at the price of another. All satisfy somebody's wants or needs and so are valuable in an economic sense.

Many natural resources are used by humans. When the value of using a natural resource increases, this increases the demand for it and, in turn, its price. As the price increases people begin to search out new sources and the supply can increase. However, rising prices cannot ensure ever-increasing supplies if the costs of finding and extracting new sources also rise (as one would expect as stocks are depleted).

Environmental Problems of Energy Use

When we extract, transport, or use energy, we affect the environment. Hydroelectric generation is relatively non-polluting, but the dams they require affect the ability of some fish to spawn and reproduce. Burning coal and oil harms air quality. Wind farms and solar collectors may be scenic nuisances. Harvesting and growing biomass can lead to loss of biological diversity, since biomass is usually grown as a monoculture (one type of plant). Nuclear energy plants create radioactive wastes. Table 3.1 summarizes some environmental problems associated with harvesting, transporting, and generating energy.



Environmental Impacts of Energy Generation

TABLE 3.1

TYPE OF FUEL	EXTRACTION	TRANSPORTATION	USE
Oil	Exploration and extraction can harm land and marine habitats.	Pipelines are used for transporting much of the oil extracted within the United States. Building and maintaining pipelines can disrupt sensitive habitats. Oil being transported may spill. If this oil reaches a waterway, the animals and plants in the water can be harmed.	Burning oil releases nitrogen oxides, sulfur dioxide, and carbon monoxides, which can combine with other chemicals to form smog. Sulfur dioxide and nitrogen oxides also can combine with water droplets to cause acid rain. Burning oil also contributes to the potential for global climatic change.[10]
Natural Gas	Exploration and extraction can harm habitats.	Natural gas is transported by pipeline. Building and maintaining pipelines can disrupt sensitive habitats.	Natural gas pollutes the atmosphere, but far less than coal or oil.
Coal	Exploration and extraction can harm habitats. Both surface or strip mining require removing vegetation and other parts of habitats. Habitat is often reclaimed, or put back, after coal is mined.	Transporting coal uses oil, and so affects air quality.	Burning coal releases sulfur dioxide, which can cause respiratory problems and acid rain. Burning coal also increases the amount of carbon dioxide in the atmosphere, contributing to the potential for global climatic change.
Biomass	Growing biomass efficiently requires monoculture — planting large areas of the same species of tree or crop. This reduces biological diversity at the site. Harvesting biomass requires fossil and other fuels, which can hurt air quality or water quality (spills).	Transporting biomass requires the use of fossil fuels, which can affect air quality.	Burning biomass results in the release of particulates and other air pollution.

[10] It's interesting to note that in the United States, sulfur dioxide, nitrogen oxide, and carbon monoxide emissions into the air have dropped since the 1970s. Currently, about 21 million tons of sulfur dioxide are emitted each year. About 19 million tons of nitrogen oxides and about 60 million tons of carbon monoxides are emitted each year. This is down from 32 million tons of sulfur dioxide, 20 million tons of nitrogen oxides, and 123 million tons of carbon monoxide in 1970. (U.S. Environmental Protection Agency, *National Air Quality and Emissions Trends Report*, Research Triangle Park, N.C.: EPA, November 1991.)

TYPE OF FUEL	EXTRACTION	TRANSPORTATION	USE
Solar	Capturing solar energy requires collectors, photovoltaic cells, or solar thermal systems. These require resources to build, some of which are not abundant. However, the environmental impact of capturing solar energy is low.	Little or no impact.	Little or no impact.
Water	Hydroelectric dams must be built on rivers to harvest water for energy use. These dams can affect fish spawning and river habitat.	Little or no impact.	Hydro plant operation may affect the biology and hydrology of the river. Temperature, clarity, and dissolved oxygen can all be affected.
Nuclear	Uranium mining disrupts habitat.	Little or no impact. Transporting uranium requires fossil fuels, and so affects air quality.	Generating nuclear energy produces radioactive wastes. The storage of these wastes presents potential pollution problems.
Wind	Large wind turbines usually are built to harvest wind for use. The machines can harm scenic views and cause noise. They also can hurt birds.	Little or no impact.	Little or no impact.
Geothermal	Power plants must be built at the site to harvest geothermal energy for use. This can harm the scenic qualities of the area. Geothermal resources in Yellowstone and Lassen national parks, for example, are protected by law from being used to generate electricity.	Little or no impact.	Little impact. Geothermal power plants release less than 4 percent of the carbon dioxide and less than 3 percent of the sulfur emitted by coal plants.

In economics, an *externality* is a cost or loss of value someone incurs without their choosing. Many environmental impacts are externalities. For example, when an electric company builds wind machines, people in the area may incur the cost of noise, loss of view, and loss of animal habitats or ecosystem functions.

ACTIVITY 3.1

WHAT IS A WILDERNESS AREA WORTH?

Ages: 9 to 18

Style: adult led, teen led

Life Skills: listening to others, expressing an opinion, disagreeing and refusing, facilitating group activities, developing intellectual curiosity, making decisions based upon personal values criteria

Pre-Activities: 1.2, 2.1, 2.2, 2.3

Time Needed: 30 minutes

Group Size: any

Indoors or Outdoors: either

Materials Needed: copies of Activity Sheet 3.1A, pencils, chalkboard and chalk or flip chart and markers

ACTIVITY GOALS

To understand and list ways natural resources provide benefits.

Preview

The economic approach to evaluating wilderness is introduced. Participants work in small teams to value a parcel of wilderness.

How to Do the Activity

Ask the group, "What is a wilderness area worth in economic terms? How would you measure it?"

Divide participants into teams of three or four. Give each team a copy of Activity Sheet 3.1A. Ask a volunteer to read the description aloud. Then ask teams to evaluate the various ways of valuing a wilderness area. Give them several minutes to discuss and complete the sheet.

When they have finished, ask teams to write (on a chalkboard or flip chart) the letter corresponding to the alternative they chose. Which alternative got the most votes?

Economics defines the value of something according to how well it satisfies people's wants and needs and how much they are willing to sacrifice to get it. This is typically measured by how much they are willing and able to pay (whether or not they actually have to pay.) Alternative (**E**) represents an true economics-based definition of the value of a wilderness area. Note that people's willingness to pay really represents how much of other goods and services they would be willing to forgo to have the wilderness area.

Evaluating Progress

Are there different ways of valuing a resource? (Yes.) Is any one way "right?" (No.) How do economists value alternative uses of a natural resource? (By how much people are willing and able to pay to see that the resource is used in a particular way. It's very important to note that while this value is sometimes reflected by market prices — especially for marketable resources such as timber, energy, and fish —unpriced goods and services such as a beautiful sunset, habitat, and ultra-violet ray protection also have economic value because they also satisfy people's wants and needs.) Can we meet all needs at all times? (No. If we leave a wilderness intact for wildlife and aesthetics, we lose minerals, wood products, etc. But opening a wilderness for mining and harvesting makes many people unhappy, too. It generally turns into a conflict.)

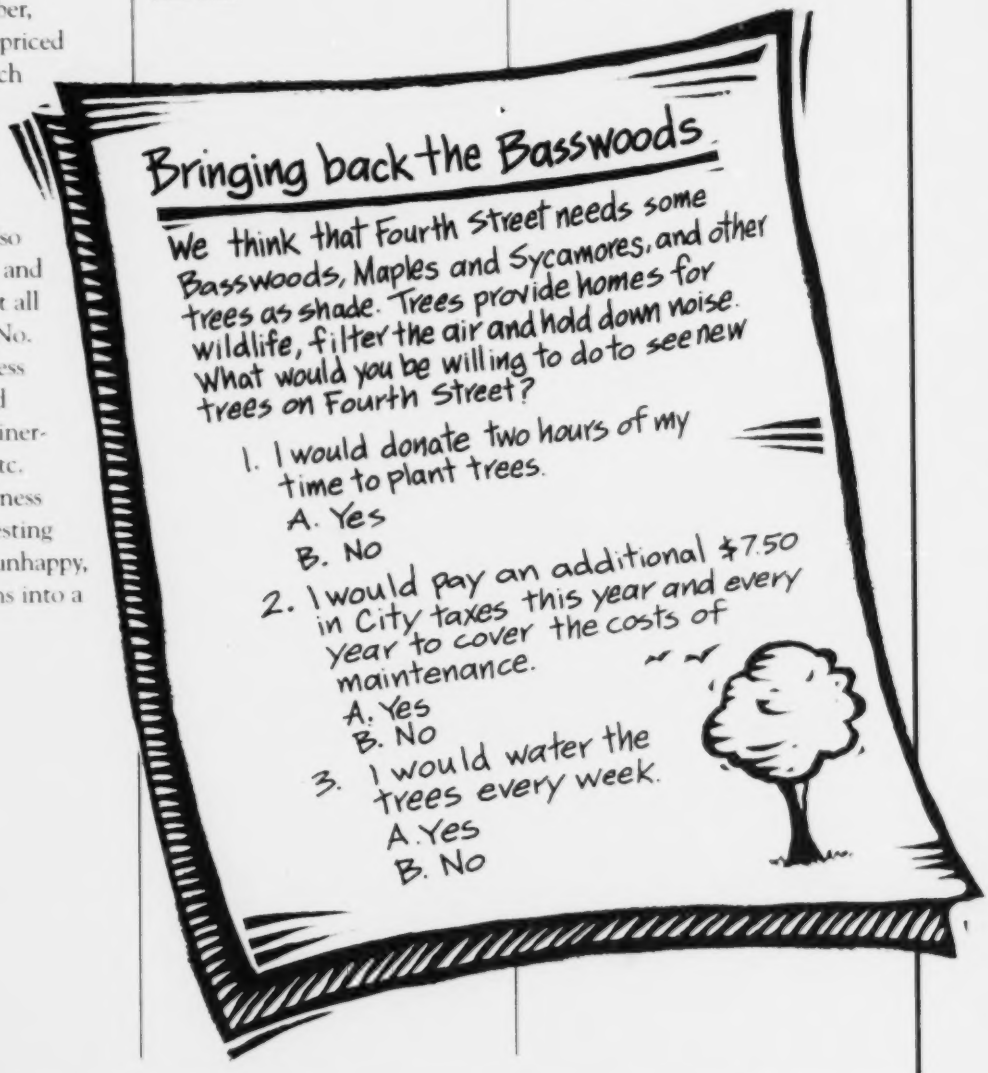
Fair Game

Design a survey or other method to discover how much people are willing and able to sacrifice (in time and money) for some aspect of local environmental quality (e.g., cleaning up a hazardous waste site, preserving a specific natural area, planting trees along certain streets).

For example, some of the questions of a survey may look like this:

One for All and All for One

What is a wilderness area worth to your group? Is there any natural area that has unique plants or animals or other interesting features close to your homes? You can adopt this area. Talk to employees of your state, country, or community natural resources or conservation office about the area. They can suggest some stewardship projects for your group such as litter patrol and tree plantings.


Bringing back the Basswoods
We think that Fourth Street needs some Basswoods, Maples and Sycamores, and other trees as shade. Trees provide homes for wildlife, filter the air and hold down noise. What would you be willing to do to see new trees on Fourth Street?
1. I would donate two hours of my time to plant trees.
A. Yes
B. No
2. I would pay an additional $7.50 in City taxes this year and every year to cover the costs of maintenance.
A. Yes
B. No
3. I would water the trees every week.
A. Yes
B. No

ACTIVITY SHEET 3.1A

WHAT IS A WILDERNESS AREA WORTH?

The 9,000 acres surrounding Rock Bottom Creek are some of the most beautiful in the United States. Lynx and moose share the surrounding forests and wetlands. Rainbow and cutthroat trout swim in Rock Bottom Creek. The land is mountainous, and high meadows support elk and deer. Beargrass and Indian Paintbrush dot the landscape with color in the summer.

The area is also rich in coal and minerals such as iron ore and copper. There is even talk of gold deposits! Right now, there is little economic activity in the area except for the few mountain climbers and campers who come each summer to enjoy the spectacular scenery. The residents of nearby Willow Springs are torn between seeing the neighboring wilderness area developed (more jobs!) or leaving it intact.

An economist comes to a town meeting to discuss how the value of the area might be calculated. She offers the following alternatives:

A. It is priceless.
No monetary value can possibly be placed on an untouched gift of nature. It must be preserved at all costs because it has an infinite value.

B. It is worthless.
Undeveloped land and unused resources generate no benefits to society nor any income for the economy. A wilderness area therefore has no value (or a value of zero).

C. It is worth the sum of the parts.
Determine the market value of all the natural resources that could be extracted or harvested from the area. For example, take the amount of iron ore times its current price per ton plus the amount of timber times its current price per cord, plus the amount of water times its current price per gallon, plus the amount of deer times its current price per animal, plus the amount of grass times its current price per bale, etc.

D. It is worth the amount of tourism expenditures it generates.
Determine the total amount of dollars visitors to the area spend on motels, restaurants, gas, souvenirs, and other items related to their visit.

E. It is worth what people are willing and able to pay for it.
Determine what each person in the society is willing and able to pay for the benefits they receive from preserving the area as wilderness. These benefits would include everything from the carbon dioxide absorption provided by plants and biodiversity preservation to the pleasure of hiking or canoeing in the area.

Decide which alternative to support. We support Alternative _____ because _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

ACTIVITY 3.2

AUCTIONING ENERGY

Ages: 9 to 18

Style: adult or teen led

Life Skills: disagreeing and refusing, expressing an opinion, observing and listening, asking questions to get information, comparing and selecting alternatives, managing resources to achieve a goal

Pre-Activities: 1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1

Time Needed: 30 minutes

Group Size: any

Indoors or Outdoors: either

Materials Needed: copies of Activity Sheet 3.2A cut apart; different types of wrapped candies

ACTIVITY GOALS

To demonstrate how natural resources such as energy are subject to the laws of supply and demand.

Preview

Participants play a game illustrating how supply and demand affect energy prices.

How to Do the Activity

Explain that prices help people decide what to buy, what to make, and what to sell. But how do you think prices are set? (Ask participants to give ideas.)

Prices are influenced by the law of supply and demand. As the price of bicycles goes down, more people want to buy them. But as the prices go down, fewer people want to sell them. So the prices may rise because the supply is influenced. As the price of bicycles go up, more people want to make and sell them, but fewer people want to buy them. In the American marketplace, the demand and supply match up fairly closely.

To demonstrate supply and demand, play the following game with the group. Give one participant a handful of candies representing a supply of an energy source (coal, oil, wood, etc.). This person will be the "Energy Auctioneer." In this situation, there is a limited supply of energy (one handful) for the entire group.

Give each person in the rest of the group 10 "dollars" from Activity Sheet 3.2A. Have the Energy Auctioneer ask people to place bids for the handful of candies. Start the bidding with one dollar. Caution participants that they will be bidding on several rounds of candies, so they probably don't want to spend all their money right away. Each round of candies may be different.

Talk about what is happening as the auction continues. Notice that as the price increases, fewer and fewer people bid (i.e., price increases, demand decreases). At some point the price gets so high that most people don't feel it's worth buying the product. Give the handful of candies to the highest bidder.

As a real-life example, note that in the 1970s the supply of oil in the United States (and other countries) was restricted by oil-producing nations. This caused prices to rise. Eventually prices got so high that people began to find ways to use less oil (lower the demand). They purchased more gas-efficient cars and conserved energy in their homes.

AUCTIONING ENERGY

In the next round of the game, something new happens. Other people want to make money too, so they decide to start selling candies. Give four people each a handful of candies different from each other. Now each of these four is an Energy Auctioneer. The supply of energy resources is much larger now.

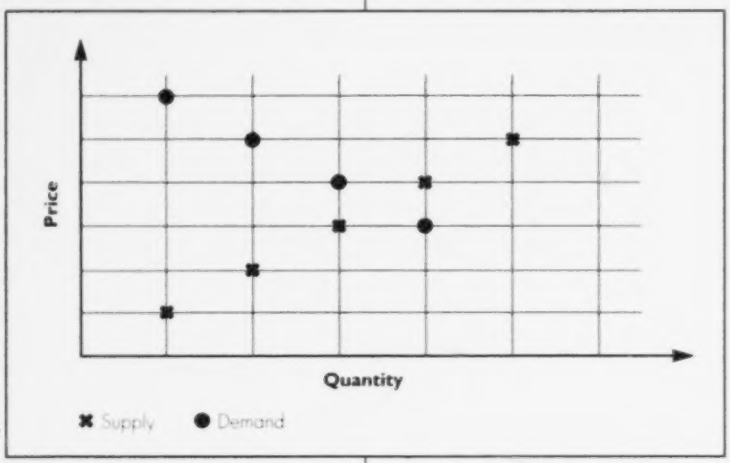
Start the bidding process again at one dollar. Have all four Energy Auctioneers try to "sell" their energy resources at the same time. What happens? As the supply increases (assuming demand is the same), prices fall.

Ask the group: Suppose only one Energy Auctioneer can sell energy resources. What would happen? (The price would rise. This is called a monopoly. The U.S. government regulates industries to discourage monopolies.) What if another energy source (for example, solar) became available? (It depends on the price of the solar energy — if it is less than the prices of existing sources of energy, people would buy it.) What would happen to the demand for the first energy source? (It would generally go down. However, it might stay stable or even increase, if more industries and businesses were started as a result of lower energy prices.)

Share the following illustration with participants by redrawing it on a chalkboard or flip chart. This will help summarize the basics of energy economics.

Evaluating Progress

Explain how the laws of supply and demand would affect the price of a favorite product (football, CD, perfume). What would happen to the price if demand increased? (Generally, it would go up.) Decreased? (Generally, it would go down.) What would happen to the price if supply increased? (Generally, it would go down.) Decreased? (Generally, it would go up.)



Fair Game

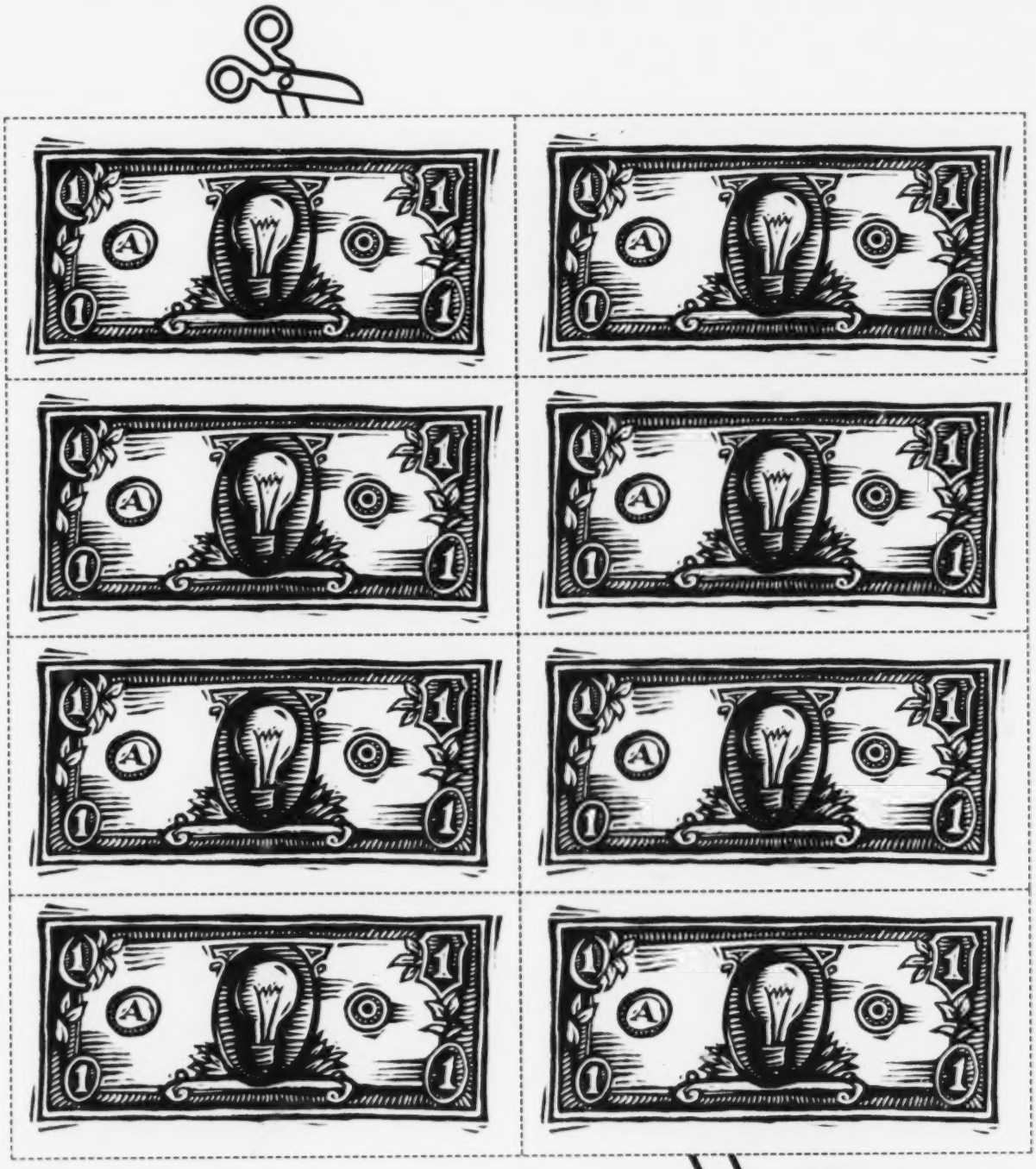
Research and report on a time in history and how energy sources were affected by supply and demand (e.g., the energy crisis of the 1970s). Show how supply and demand affected energy prices and the effect that had on people's lives.

All for One and One for All

Help residents in your community who have difficulty paying for energy by offering to weather strip their homes or provide other energy saving work. Your local utilities might have similar programs already in place that you can volunteer for. Be sure to evaluate as best you can whether your action saves energy. Ask yourself: if we replace the light bulbs in a den with low wattage ones, will people just use more lamps to do the same jobs? If we help people block drafts at the bottoms of their doors, are we using materials that provide a good return, since it took energy to make the products in the first place? Think about it, and help educate people about using energy and other resources wisely.

ACTIVITY SHEET 3.2A

Auctioning Energy



ACTIVITY 3.3

FROZEN PIZZA OR FRISBEES?

Ages: 13 to 18

Style: adult led

Life Skills: asking incisive questions, expressing an opinion, speaking persuasively, organizing groups to accomplish a purpose, making decisions based upon personal values criteria, managing resources to achieve a goal, expressing values

Pre-Activities: 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2

Time Needed: 30 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of cards from Activity Sheet 3.3A, pencils

ACTIVITY GOALS

To understand the term trade-off and give examples in environmental and energy use decisions.

Preview

Participants discuss the term trade-off. In teams of four to five, they review trade-off cards and come to a consensus. They share their decisions with the rest of the group.

How to Do the Activity

Begin by discussing the term trade-off with participants. Trade-offs are part of everyone's everyday life. They are the things we do (or make) at the expense of other things because we feel the benefits outweigh the costs. Ask participants to name some trade-offs. Their ideas might include:

- Doing homework instead of watching television.
  Benefit: you'll get an A.
  Cost: you'll miss your favorite show.
- Going to a movie instead of skating.
  Benefit: you'll get to see your favorite actor.
  Cost: it will be more expensive.
- Eating hot dogs instead of hamburgers.
  Benefit: it's cheaper.
  Cost: hot dogs don't taste as good.

We also encounter trade-offs when we make and use things. This is because most natural resources are scarce — they simply cannot provide everything we want.

Divide participants into teams of four to five. Give each team one or more cards (depending on time) prepared from Activity Sheet 3.3A. Teams must work together to come up with a consensus on the trade-off. A consensus means that everyone agrees with the decision. Many of the trade-offs are between environmental quality and other goods. If they can't reach a consensus, they must state that as well.

Give teams several minutes to debate, then have them share their cards and decisions. Did the team come to a consensus? Was it difficult? Poll the rest of the group to see if they agree with the decision.

Evaluating Progress

Trade-offs for the various scenarios are as follows:

1. The trade-off is between maintaining animal and plant habitat and using a cleaner burning, renewable fuel.

2. The trade-off is between using a product made from a nonrenewable resources and using one made from a renewable resource that will not perform as well.

3. The trade-off is between clean, cheap fuel (and your mother's job) and an intact salmon population.

4. The trade-off is between clean, cheap transportation (bicycle) and the convenience of a bus or car.

5. The trade-off is between saving money and helping the environment on one hand, and convenience, speed, and less sweat on the other.

6. The trade-off is between speed and money, convenience, and energy.

Fair Game

Trade-offs are part of our lives everyday. If we had endless resources, we could have anything and everything we wanted! (But then we'd have to find a way to deal with wastes and residues of such rampant consumerism!) Make a photographic exhibit of environmental decisions you make every day that produce a trade-off.

One for All and All for One

Think of a natural resource that is scarce in your community (e.g., trees, clean air, clean water, animals) As a group, think of ways you can increase the amount of this resource so that everyone can enjoy it. Would increasing the amount of this resource cause economic hardship to your area? Are there reasons the natural resource isn't present in larger amounts? Answers to these questions might give rise to a stewardship project such as improving habitat for wildlife, planting trees, or monitoring stream water quality.

Frozen Pizzas or Frisbees?

ACTIVITY SHEET 3.3A

1. You are a resident of Fire Falls, Minnesota. The local forester has convinced your electric cooperative to burn fast-growing poplar trees instead of coal to meet the electrical needs of the town. The forester wants to turn agricultural fields and forests into poplar plantations. Local farmers would be paid for raising trees as a crop. The cost of generating electricity would be about the same as it is for coal and tree-burning would cause less air pollution. The problem: It would take thousands of acres of trees to provide electricity to your town. You're worried that a lot of habitat would be ruined by the tree plantations. Pheasants and deer depend on the fields, and more types of animals and plants live in existing forests than would live in poplar plantations. Do you support the poplar-based energy project?

Decision: _____

Benefit: _____

Cost: _____

Was a consensus reached? _____

2. You are the regional frisbee champion. You can toss and spin frisbees in any direction and at any speed. Even your dog "Herekitty" performs, leaping into the air to make spectacular catches. Earlier this year, you decided to boycott all items that weren't made from renewable resources, since you think this will help the environment. You think you should use only the things in nature that can be grown again. You know that your beloved frisbee is made from plastic. But you feel honor-bound not to use a plastic product. You and Herekitty experiment with lots of frisbee substitutes. You try construction paper disks, disks woven from grass, disks made from cotton cloth, and even frozen pizzas, but alas, none of your homemade concoctions can match the spin of a frisbee. The state championship is coming up. Will you enter the contest with a plastic frisbee?

Decision: _____

Benefit: _____

Cost: _____

Was a consensus reached? _____

3. You are an angler in Great River, Washington. You love to fish for salmon in the local large river. However, lately your catches have become smaller and smaller. Now there are restrictions on fishing. Local news reports blame the loss of fish on the hydroelectric dam. They say the dam interrupts fish spawning and destroys habitat. But an uncle tells you that the hydroelectric dam provides cheap energy and helps the economy by providing jobs and enticing other companies to move here and bring jobs (partly because of the inexpensive fuel). He points out that your mother could lose her job if another source of energy were used, since she works in a factory that relies on cheap electricity to make a small profit. Your uncle also says that hydropower is very, very clean. Do you support hydropower?

Decision: _____

Benefit: _____

Cost: _____

Was a consensus reached? _____

4. You've just landed your first job and boy, are you excited. You've been hired as the Lobster Kid at the local seafood restaurant. You get to walk around to all the tables, dressed as a lobster, and say "Do you need a PINCH of seasoning?" You then salt or pepper the patron's food accordingly. You'll be paid pretty well and get tips, too. However, your father is not very happy about your new employment. He points out that the seafood restaurant is nine miles away, and wants to know how you'll get back and forth to work. You suggest he drive you, but your idea is met with a blank stare and a grimace from your father. You have three other options: take a bus, ride your bike, or buy a car. The bicycle would be free except for upkeep. The bus would cost about $3.00 each time you work. The car, you figure, would cost about $11.00 each trip if you worked for two years (cost of car, insurance, upkeep, and gasoline divided by the number of times you'd work). The bicycle ride would take one hour; the bus ride, 35 minutes; the car ride, 14 minutes. Which do you choose?

Decision: _____

Benefit: _____

Cost: _____

Was a consensus reached? _____

5. You're thinking of starting a lawn-mowing business. You need to decide whether to use a push mower or gas-powered mower. It would take longer to mow lawns using a push mower, but you'd save money on fuel. (Adults pay for food in your home, so any extra calories you burn by using a push mower wouldn't cost you anything.) On the other hand, you might be able to mow more lawns with the gas-powered mower, and make up the difference. You also want to consider environmental factors. A gas-powered mower pollutes the air. The only pollution from the push mower is sweat! What do you decide?

Decision: _____

Benefit: _____

Cost: _____

Was a consensus reached? _____

6. This is your very lucky day. You've been saving money for months and now you're ready to buy that toy you've been longing for. You walk into the boat store with enough money for a used jet ski — a one-seater boat. You'll have to borrow a trailer and pickup truck every time you want to use the jet ski. You figure you can probably get to the lake four or five times a month to ride. On your way into the store, you pass a new kayak. It's about the same price as the used jet ski. You begin to think about the differences . . .you wouldn't need gasoline for the kayak, and you could strap it to the top of your old beater car. You could go to the lake just about everyday! Still, a kayak isn't as fast as a jet ski. What do you buy?

Decision: _____

Benefit: _____

Cost: _____

Was a consensus reached? _____

ACTIVITY 3.4

CHANCES AND CHOICES

Ages: 13 to 18

Style: adult led

Life Skills: managing resources to achieve a goal, asking incisive questions, expressing an opinion, speaking and writing persuasively, thinking globally

Pre-Activities: 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3

Time Needed: 50 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of Activity Sheets 3.4A or overhead projector and transparency of Activity Sheet 3.4A, copies of Activity Sheet 3.4B, pencils

ACTIVITY GOALS

To demonstrate that natural resources such as land have several alternative uses. To describe the trade-offs involved in choosing one alternative over another.

Preview

Participants discuss the alternative uses of natural resources using Activity Sheet 3.4A. They also discuss the trade-offs involved in resource decisions. Finally, participants consider South Africa and how it will use its natural resource base.

How to Do the Activity

Ask participants to list all possible uses of a tree in a forest. You may want to prompt them with questions such as "How would you use a tree?" or "Do trees provide things we don't always pay for?"

Their lists will likely include consumptive uses, such as:

- energy when burned for cooking, heating, and manufacturing;
- timber for use in wood products such as homes, furniture, and pencils;
- wood pulp for use in paper products such as newspapers and books;
- leaves for use in composting and gardening.

Their lists also may include nonconsumptive uses such as:

- carbon dioxide absorption to reduce the potential of global warming;
- scenery, shade, and something to climb;
- wildlife habitat

Hand out copies of Activity Sheet 3.4A or display the transparency on the overhead projector. This sheet generalizes the idea of multiple uses to all natural resources and illustrates how these uses satisfy the wants and needs of people. Have the group suggest specific examples for each term in the diagram.

Answers might include:

- *Stock of Natural Resources:* minerals, animals, plants, wetlands, oceans, forests, ozone layer, air, fossil fuels, canyons, the sun
- *Energy/Raw Materials:* oil, natural gas, coal, solar energy, wood, tuna, cattle, water, air, timber, iron ore, mercury, crops
- *Goods and Services:* hamburgers, pizza, cars, computers, haircuts, education, medical care, movies, clothes, transportation, soft drinks, houses
- *Wastes (from production):* sawdust, paper pulp, solvents, scrap metals, ash, gases
- *Wastes (from consumption):* packaging, soft drink cans, sewage, newspapers, junk cars, garbage, old clothes
- *Recyclable Materials:* aluminum, newsprint, plastics, glass, scrap metal, paper, tin cans, cardboard
- *Wastes (into the environment):* gases (from incineration), garbage and demolition materials (due to landfilling), oil spills, litter, "treated" sewage
- *Environmental Quality:* life support products such as air, water, ultraviolet ray protection, carbon dioxide absorption, and habitat, as well as amenity services such as hiking through a forest, spotting a plant or animal, viewing a sunset, and having a place to relax (note that the total environmental quality is defined by the quantity of these products and services).

Note that the diagram suggests three general ways natural resources satisfy our wants and needs:

- As inputs in the production of goods and services.
- As inputs in the production of environmental quality (which basically amounts to leaving them alone!).
- As inputs in waste management to reduce the impact of wastes on environmental quality.

Point out that natural resources are finite, so we face trade-offs — using them one way means less is available to use in another way. Ask the group to use the diagram to suggest examples of trade-offs.

Answers might include the following:

- Using a river canyon as a scenic area or damming the river to produce electricity
- Using wetlands as wildlife habitat or draining them to produce crops
- Using a river for trout fishing or for irrigation
- Using an old growth forest to produce wood or wildlife habitat
- Using minerals to produce cars or pollution control equipment
- Using an area as a wilderness or extracting coal from it.

Explain to the group that in making choices , it's natural to compare values of the alternatives, and it's reasonable to suggest that the alternative that yields the greatest value is the best choice. This is essentially the economic approach to natural resource use.

Divide participants into teams of three or four. Give each team a copy of Activity Sheet 3.4B. Give teams several minutes to read the scenario, then describe how they would use South Africa's coal resources.

Let teams share their ideas. Did they decide to harvest the coal? Why or why not? What other choices did they make? How did lack of information influence their decisions? Is it important to be informed before making decisions?

Evaluating Progress

What uses does a river have? (Boating, swimming, fishing, habitat, irrigation, drinking water, industrial uses, etc.) What uses does a barrel of oil have? (Energy source for manufacturing, gas for cars, raw materials for plastics, energy source for waste control, etc.)

How are trade-offs involved in choosing how to use a river or a barrel of oil? (Using the resource in one way usually means it must be used less in another way. For example, irrigation reduces river flow, making boating more difficult and supporting a smaller stock of fish; oil burned today to generate electricity can't be used to produce football helmets or burned tomorrow to generate heat.)

Fair Game

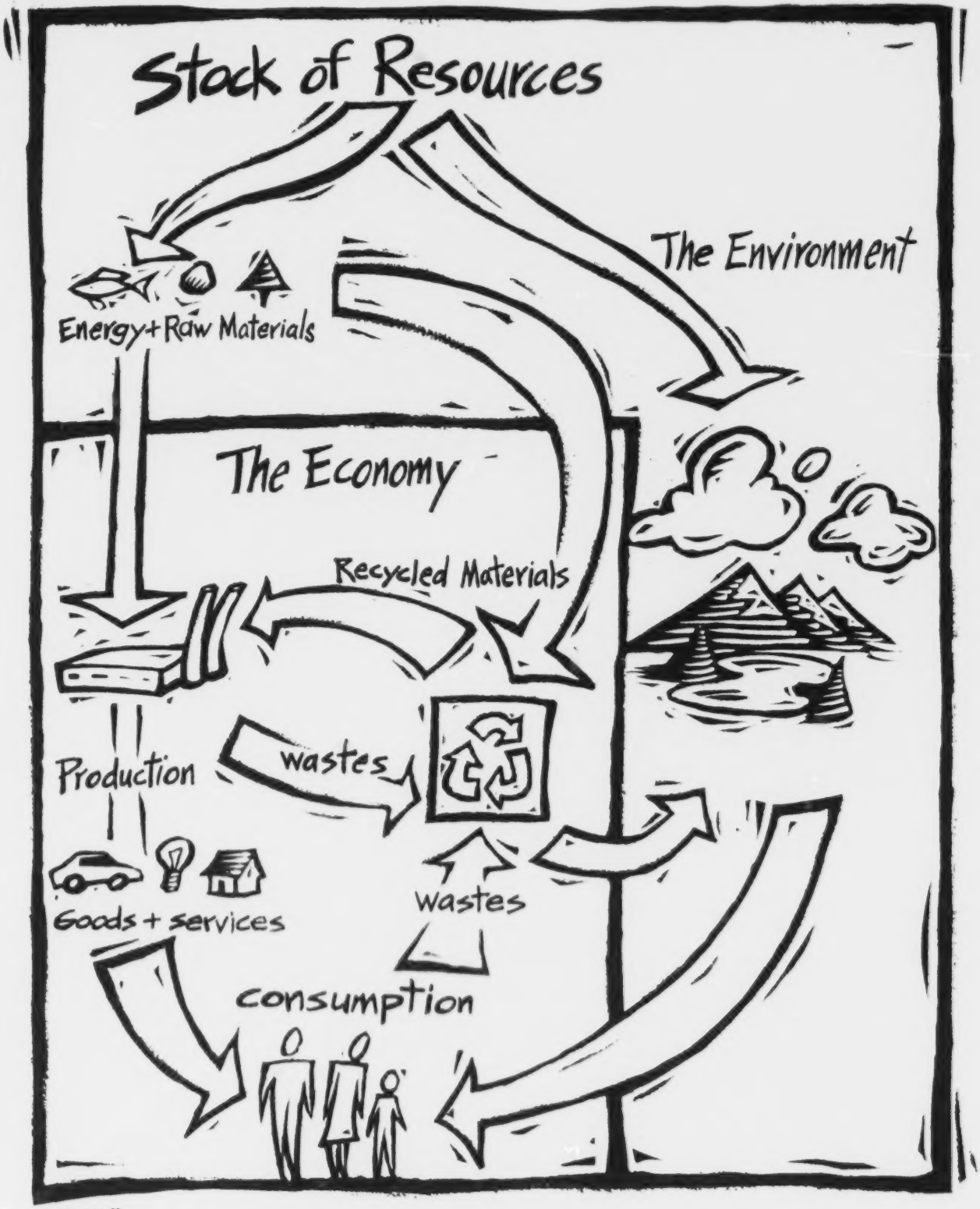
Create a life-cycle inventory of a product. Select common consumer products such as a CD player, box of cereal, piece of furniture, or a can of soda. Through letters to the manufacturers and suppliers, investigate which raw materials and energy resources were used to make this product. Track these resources back to their geographic origins. For example, the electricity used might be from a coal mine in southern Montana, while paper might be from a forest in northeastern Minnesota. Present a complete flow diagram from beginning resources to final product.

One for All and All for One

As a group, pick a specific source of natural resources (e.g., a forest or wilderness area with oil resources). Construct a model or display of its use based on Activity Sheet 3.4A. What energy or raw materials can be found in the area? What products can be made? What goods and services can it provide? What about environmental quality benefits? Use your model or display to teach others!

ACTIVITY SHEET 3.1A

Chances and Choices



ACTIVITY SHEET 3.4A

CHANCES AND CHOICES

South Africa is one of the most beautiful countries in the world. It also is rich in coal reserves. The Transvaal region in the northeast is one of the world's richest mineral areas.

People who live in South Africa can choose to mine the coal and use it for their own energy needs and to further industrialize the country. To do so would mean some loss of habitat. Some places would become less scenic, and tourism dollars would shrink. If coal were mined, less land would be available (at least temporarily) to farm potatoes, sunflower seeds, and maize.

Some natural resources of South Africa:

- crops such as maize, beans, and potatoes
- breathtaking scenery, including waterfalls and unspoiled coastlines
- antelope, zebras, leopards, and other animals
- coal and other mineral resources
- the baobab and other trees
- rich soil

How would you use these resources if you lived in South Africa?

1. as inputs in the production of goods and services.

2. as inputs in the production of environmental quality (which basically amounts to leaving them alone!).

3. as inputs in waste management to reduce the impact of wastes on environmental quality.

Describe how you would use these resources:

Now that you've described your opinions, discuss the following:

1. What are the needs of the people in South Africa? Are the people wealthy or poor? How would this information affect your opinions?

2. Are there alternative sources of fuel? How would knowing this affect your answer?

3. How much waste does South Africa generate? How would knowing this affect your answer?

4. What other information would you need to make informed choices about the resource use? Is it important to collect all the facts before making decisions?

Chapter 4

Efficient Worlds

A Whole Lot of Something from Something. What does it mean to be energy efficient? Simply put, it means doing work with the least amount of waste possible. You are being energy efficient if you carry several toys up the stairs at one time instead of going up and down for each one. The more toys you carry up the stairs, the fewer trips you have to make, and the more energy efficient you are. An automobile that averages 47 miles per gallon of gas is more energy efficient than one that gets 19 miles per gallon. The trade-off is that the less efficient model is probably larger and safer.

Why are people and businesses so concerned with being energy efficient? There are many reasons. Energy costs money. By reducing energy use, people and businesses can potentially save money. And energy use does harm the environment. Getting the same result using less energy is the goal of energy efficiency.

For businesses, energy is one of many inputs (machinery, labor, other raw materials, etc.) used to make something of value. If we remove any one input, production stops. However, more of one input can sometimes substitute for less of another.

Businesses also are concerned about minimizing the total cost of making their product (widgets, ice scrapers, espresso machines, or whatever). While being energy efficient helps reduce costs in general, a business might choose to use more energy inputs if by doing so it can save on other inputs (e.g., raw materials, machinery, or labor), and so make the product less expensive for consumers. If consumers want a business to reduce energy inputs, they might have to be willing to pay more.

What Goes In

Products differ in the energy and environmental impacts required to bring them into our homes. For example, plastic patio furniture may require more energy overall than redwood patio furniture. Refining and molding are energy-intensive activities. It's important to think about the environmental and energy consequences (costs) of our buying habits.

ACTIVITY 4.1

NO WASTED WORK

Ages: 5 to 12

Style: adult or teen led

Life Skills: trying new things, working together cooperatively, gathering information to solve problems, developing intellectual curiosity, refining small motor skills

Pre-Activities: 1.1, 1.2, 1.3, 1.4

Time Needed: 25 minutes

Group Size: any

Indoors or Outdoors: either

Materials Needed: Activity Sheet 4.1A cut apart (one card per team)

To define efficiency as getting the most out of something.

Preview

Participants are asked to do various activities without wasting any movement.

How to Do the Activity

Ask participants to define energy efficiency. (Energy efficiency is doing work without waste). You may want to demonstrate something that minimizes energy, for example, reaching a book on a high shelf using a chair versus jumping up and down several times to knock it loose.

Divide participants into teams of two (pair nonreaders with older children or teen or adult leaders). Give each team one of the "No Wasted Work" cards from Activity Sheet 4.1A. Have participants read the situations on the cards and talk about how they would act them out using the least amount of energy. Each team should practice its solution several times, eliminating unnecessary actions.

Let each pair act out its situation to the whole group. Have the other group members suggest how they could reduce even further the amount of energy they use.

Evaluating Progress

How can other forms of energy be used more efficiently? What are some ways to reduce energy used in your home? In the family car? At school?

Fair Game

Develop a game that illustrates the concept of energy efficiency. Play it with friends or others. It could be like "Simon Says" or other familiar games!

All for One and One for All

Challenge each other to turn off lights in your houses when they are not being used. Share your success stories at your next meeting.

ACTIVITY SHEET 4.1A

No Wasted Work

1		Making scrambled eggs for breakfast.
2		Cleaning your room.
3		Picking out food at the grocery store.
4		Jumping rope with a friend.
5		Reading a book.
6		Playing with your dog.
7		Dancing to music.
8		Playing the drums.
9		Brushing your teeth.
10		Getting on the school bus.

ACTIVITY 4.2

88.5 QUADRILLION AND COUNTING

Ages: 9 to 18

Style: adult, teen, or self led

Life Skills: learning through experience; asking questions to get information; pursuing independent learning; conducting systematic inquiry; understanding scientific and technological ideas; making decisions affecting others; identifying problems; gathering information to solve problems; choosing to make changes; leading change; expressing ones values

Pre-Activities: 1.1, 2.4, 2.5, 4.1

Time Needed: 20 minutes plus one to two hours at home

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of Activity Sheet 4.2A, pencils, chalkboard and chalk or flip chart and markers

To analyze how individuals can become energy efficient and how this affects their well-being.

Preview

Participants conduct an energy audit in their homes.

How to Do the Activity

After you complete Activity 4.1, participants will understand energy efficiency. Next, let them score their homes' performances!

Hand out copies of Activity Sheet 4.2A. Ask participants to audit their homes for energy efficiency. They may need the help of an adult or older sibling to complete the audit. They'll also need to understand the terms cost and benefit.

The next time you meet, compare the results of the energy audits. Tabulate responses to each category on a chalkboard or flip chart (e.g., 15 out of 23 shut off heat in rooms that aren't being used). Be sure to discuss costs and benefits of each situation. Are there any categories that have low amounts of participation? Is the cost/benefit ratio (what it costs versus what's gained) high in these categories? Is the opposite true in the categories with high participation?

Tell participants that we use more than 88.5 quadrillion Btus of energy each year in the United States. Is this number likely to increase in the future? Decrease? What things make this number change? (Growth in population and consumption makes energy use go up. Increasing efficiency and decreasing demand for things make it go down.)

Encourage participants to take further action through the Fair Game or One for All and All for One sections on the following page.

88.5 QUADRILLION AND COUNTING

Evaluating Progress
What is energy efficiency? Why should we worry about wasting energy? (Many energy sources are finite, so we must use them wisely.) Does using energy affect the environment? (Yes! See Chapter Three Background.)

Fair Game
What did you identify as a problem area on your audit? Does your family waste hot water? Over cool the house in summer? Identify an area for improvement. Take steps to improve the situation, such as planting trees or sealing room air-conditioning units. Chronicle your efforts on videotape or on a three-panel display.

One for All and All for One
Which areas were identified on the home energy audits as needing the most improvement? Turning off lights when they aren't being used? Installing weather stripping on windows? Pick a category that your group really needs to improve upon. Create an action plan for saving energy in that area. For example, how could your group help increase the percentage of homes that have deciduous trees planted around the house for cooling? Why not organize a tree planting weekend? The possibilities are endless!

Why is a home energy audit important?
Saving energy can help reduce our use of natural resources such as coal and natural gas. It can reduce the amount of waste produced when generating electricity. It may also save money!

How much energy do we use? In the United States, we use 88.5 quadrillion Btus of energy each year. That's enough energy to light an entire house for 200,000 years! Our homes use 20 percent of this amount, or about 17 quadrillion Btus of energy a year. More than half the energy used in our homes goes into heating and cooling. The rest is used to heat hot water, for lighting and cooking, and for running appliances.

The home energy audit on the next page, lists actions you can take to help reduce the amount of electricity used in your home. Check off the things you or an adult in your home generally do. Then write the benefit and cost of taking the action. For example, you may urge your parent to use a home air conditioner less. They'll open the windows instead. But what if you have hay fever or other allergies? The benefit may be saving energy. But the cost is a lot more sneezes!

ACTIVITY SHEET 4.2A

88.5 Quadrillion and Counting

CATEGORY	WE DO THIS NOW AT MY HOME	COST	BENEFIT
LIGHTS Turn off lights that aren't being used.			
Keep light bulbs clean. Dust makes the light dimmer, so you may turn on more lamps.			
Use natural light from the sun when possible.			
HEATING Keep the thermostat set below 68°F when at home. Just put on a sweater!			
Turn the heat down at night or when nobody's home.			
Make heat a prisoner! Shut curtains at night to keep in the heat.			
Keep furnace filters clean.			
Does your home have weather stripping? Are cracks caulked? Ask a parent!			
COOLING Use your oven during the coolest parts of the day (e.g., early morning).			
If it's colder outside than inside, don't run an air conditioner.			
Plant deciduous trees (trees that lose their leaves in the autumn) around the south and west sides of your house.			
Burrow to keep cool! Find the coolest part of your home (the basement, for instance), and chill out instead of running the air conditioner.			
WATER HEATING Use hot water only when you really need it.			
Wash clothes in cold water.			

CATEGORY	WE DO THIS NOW AT MY HOME	COST	BENEFIT
WATER HEATING If you take long showers, take a bath instead. If your showers are short, forget the bathtub. Use whichever takes the least amount of water.			
Ask a parent to fix faucets that are dripping hot water.			
If you're going on vacation (like to the Reptile Gardens), remind a parent to turn the hot water heater down.			
USING APPLIANCES Turn the TV off when no one is watching it. (This is a no-brainer!)			
Use full loads when you use a washer.			
Try drying clothes on a line in nice weather.			
COOKING Keep the oven door closed! Don't keep peeking at your chocolate chip cookies — watch the clock instead.			
Check that you've turned off the stove when you're done cooking.			
Use a microwave oven when you can. It uses less energy than a conventional oven.			
GETTING THERE Catch the bus to school. More people riding means less fuel used per person.			
Combine errands when using a car.			
Carpool!			

Talk with your family about your home energy use. Look at the benefits and costs of specific energy-saving changes. *List below three changes you might make:*

1. _____

2. _____

3. _____

ACTIVITY 4.3

TENNIS SHOE BLUES

Ages: 13 to 18

Style: adult led

Life Skills: asking incisive questions, listening to others, asking questions to get information, understanding scientific and technological ideas, comparing and selecting alternatives, making decisions affecting others, thinking globally

Pre-Activities: 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4

Time Needed: 30 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: chalkboard and chalk or flip chart and markers, paper and pencils

To examine the energy that goes into a single consumer product.

Preview

Participants identify the inputs required to produce something they recently purchased.

How to Do the Activity

How do we decide which products to buy? We spend billions upon billions of dollars each year for things that make our lives better. They represent our needs and wants.

Ask participants to think of something they bought recently (other than food) — CDs, paper, clothing, and so on. Have each write down a recent purchase on a piece of paper.

Now ask participants what forms and amounts of energy were used to make the items. Ask them to write or draw the item at the bottom of the paper. At the top of the paper, ask them to write the first step in producing the item. Did it involve harvesting or extracting a material, such as wood or oil (for plastic)? Next, they should think about transporting the raw material. Was it transported by truck? By train? By pipeline? Let them write or draw this step under the first one. Continue drawing or describing the following steps:

- Did it need to be refined or processed? (Oil must be cracked or refined; wood must be sawed, dried, and milled.)
- How was it made into the product you bought? (Molding? Assembly and finishing?)
- What type of packaging did it use?
- How did it get to where you bought it? How far did it come?

By the time participants are through, they should have long vertical diagrams (with arrows) showing the steps involved in making the things they bought.

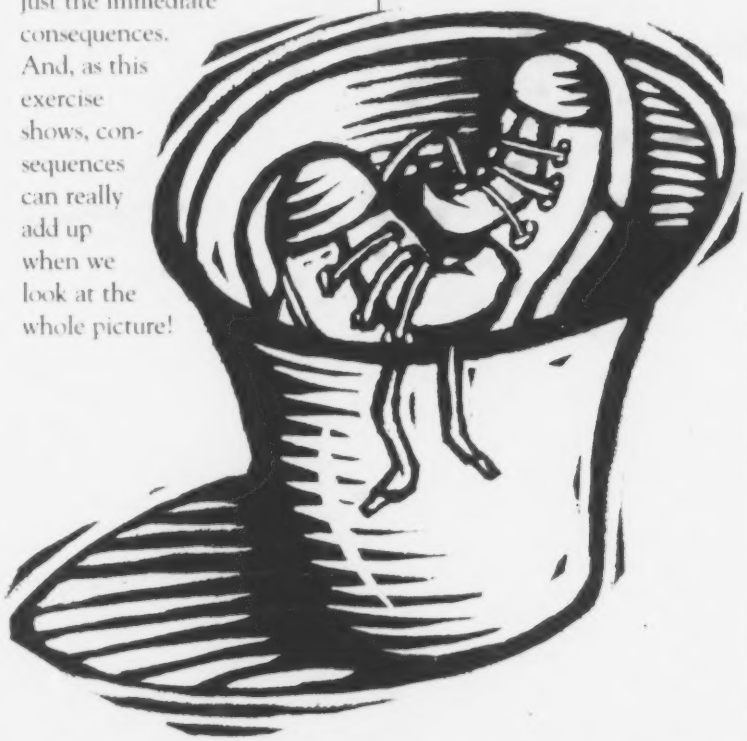
Ask participants to write the names of the items they bought on a chalkboard or flip chart. Give everyone a single sticker or marker. Ask them to place a sticker or mark by the item that they think requires the most energy to get from raw material to our homes. Give participants a few minutes to decide.

TENNIS SHOE BLUES

Ask the person who bought the product receiving the most votes to draw the diagram on the board. Is it long? Is much energy used to make the product? Ask some other top vote-getters to draw their diagrams on the board. Reach a class consensus on which product required the most energy.

Now ask participants what happens to products when the owners no longer want them. Where do tennis shoes, skates, and pens go? Do they end up in the garbage? At garage sales? Recycled? In a basement storage room for many years? How much energy is required to dispose of these items?

Remind participants that we have to think about the long-term results of our actions, not just the immediate consequences. And, as this exercise shows, consequences can really add up when we look at the whole picture!



Evaluating Progress

Name some energy-using steps required to make common products. (Mining, harvesting, transporting, refining, milling, molding or assembled, and transporting to market.) Name some environmental consequences of using products. (Environmental costs of mining, harvesting, production, and transportation include water pollution, landscape and wildlife impacts, and air emissions.) How can we minimize these? (By considering the inputs when deciding whether to buy a product.)

Fair Game

Pick a product and thoroughly research the amount of energy and the environmental impacts required to bring it into your home. Mount the product on poster board and describe the inputs and impacts. You may have to write to the manufacturer to find out exactly how it is made. The manufacturer also can tell you where it buys the raw material and how far the product travels before it reaches your home. A toothpick, for example, may travel several thousand miles, from a tree in the northern United States to Taiwan for processing, then to New York to be sold to restaurants.

One for All and All for One

What happens to the environment when we buy a video-cassette recorder? A shirt? A computer disk? Everything we do affects the environment in some way. As a group, declare an Environmental Awareness Day. Display your product diagrams in a central location. Challenge others to think of how they affect the environment. From eating breakfast to going to school to cruising the mall, all of our actions have some effect on the earth.

notes:

Chapter 5

Global Issues, Future Trends

Energy Consumption Around the World. Fossil fuels account for 64 percent of the fuel we use to generate electricity around the globe. This means that coal, natural gas, or oil provide the energy for six out of every ten switches that are flipped in a day. And four of these six are energized by coal — the global king.

Some countries use many different types of fuels to generate electricity. Finland, for example, uses coal, oil, hydroelectricity, peat, natural gas, and nuclear energy. Other countries rely very heavily on one type of fuel. Poland, for example, uses mainly coal.

Developed countries such as Canada and France tend to use energy in about the same amounts as they have for the last few decades. In other words, their consumption is stable. Consumption in developing countries such as Ecuador and Pakistan is growing. But developed countries still consume far more energy than developing countries.

Who Has What?

The United States has the largest known coal reserve in the world. The Middle East and Russia are the richest in terms of crude oil and natural gas. And uranium, used to generate nuclear energy, is found in great quantity in Australia. South Africa and the United States also have large amounts of uranium.

Who burns the most wood for fuel? India, followed by China and Brazil.

Countries use the energy resources that are cheapest and most available. Residents of Brazil collect tree branches from forests to use for cooking and heating. People in the United States rely on coal to generate electricity since it is

readily available and cheaper than many other energy resources. Rarely does the externality of loss of environmental quality enter into the choice of fuel sources.

World Alternative Fuels

Alternative fuels are those chosen in place of another. Natural gas is an alternative fuel when it is used instead of coal because of the air pollution associated with burning coal. However, most people mean alternatives to fossil fuels when they talk about alternative fuels.

Many of the world's residents rely on wood, hay, twigs, dung, agricultural residues, and other vegetable matter to cook their food and heat their homes. Despite recent increases in commercial energy consumption in developing countries, these biomass fuels are still the major source of energy for nearly half the world's population.[11] Half of all the wood used in the world is utilized to generate energy. Nepal, Uganda, and Ethiopia are three countries that draw much of their energy from fields and forests.

Growing Concerns

As the world grows rapidly, our fuel needs grow, too. It took from the day the first human put his or her foot onto the clay of the earth until the year 1800 for the world population to reach one billion. By 1930, there were two billion people. By 1965 there were three billion and in the blink of an earth eye (15 years) there were four billion. The population of the world stands at almost six billion people today. It could double within the next century. Each minute, new humans are born that will use energy and other natural resources every day of their lives.

Are We Doing Enough to Plan for the Future?

It's difficult to estimate how many years' worth of fossil fuels and uranium we have in the world, since projections are usually based on current known resources and consumption. For example, some estimates place North American reserves of natural gas at 50 years at current consumption levels. But extending current estimates about fossil fuel use indefinitely into the future may not work. Economic factors influence supply and demand. Natural gas, as it becomes scarcer, will become more expensive. If this were 1800, for example, we might be worrying that there aren't enough whales to supply all the whale oil we need for our lamps — when what really happened is that kerosene replaced whale oil, sparing the mighty marine mammals.

It is doubtful that we will wait to look for alternative sources of energy until natural gas wells run dry. Rather, as natural gas reserves are depleted, the price of natural gas will rise. This will encourage exploration for more reserves, conservation, and the search for alternative sources of energy.

But are we adequately conserving our resources? Yes . . . and no. Americans have certainly become more efficient at producing and transporting goods. But our lifestyle demands, our desires for goods and services, are increasing. A recent survey[12] found that almost 40 percent of respondents felt that the United States as a whole could cut down on consumption more than they personally could. Many people feel their own individual actions to conserve are just a drop in a puddle. They feel it's really up to others to make the big gains.

[11] United National Environment Programme, *Environmental Data Report 1993-94* (Washington DC: World Resources Institute, 1994).

[12] Mary Hoff and Jim Bowyer, *Materials and the Environment: Wood as a Global Resource Leader's Guide* (St. Paul: University of Minnesota, Minnesota Extension Service, 1995).

ACTIVITY 5.1

GLOBAL LIGHTS

Ages: 9 to 18

Style: adult led, teen led

Life Skills: expressing an opinion; speaking before a group; observing and listening; valuing diversity; asking questions to get information; comparing and selecting alternatives; thinking globally; expressing ones values

Pre-Activities: 1.1, 2.1, 2.2, 2.4, 2.5, 3.4

Time Needed: 45 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of Activity Sheet 5.1A, pencils, chalkboard and chalk or flip chart and markers

ACTIVITY GOALS

To gain awareness of world energy consumption, production, and environmental problems.

Preview

Participants use a handout to discuss world energy use, production, and environmental problems.

How to Do the Activity

Imagine life in another country. What would a typical day be like? How would daily chores and activities differ?

Explain to participants that you'll be exploring the differences in energy use between the United States and another country.

Hand out copies of Activity Sheet 5.1A. Give each person a few minutes to study and answer some questions on the sheet. Discuss the answers. Discuss the trends in relative energy use for developing and developed countries. (See "Evaluating Progress.")

Why is the United States such a large user of energy? (The United States is highly industrialized. We also enjoy a very high standard of living. Many Americans have home heating, air conditioning, and appliances. We also love our fuel-consuming cars. Americans have more than one car for every two people — the highest rate in the world. China and Brazil have one car for every 1,000 people.)

How would a day in the United States be different than, say, a day in Haiti? How would you cook your food? Wash your clothes? Heat your home?

Ask if there is any correlation between the environmental problems and energy use and production. Make a list on a chalkboard or flip chart of each environmental problem and how energy production may contribute to them. For example:

Environmental Problems	Can Be Caused By . . .
Acid rain] →	*Burning fossil fuels*
Groundwater depletion] →	*Using geothermal energy; using water to process fuels such as coal*

Ask the group to pick a country and discuss its energy use and environmental problems in more detail. The following questions will help you lead the discussion.

- What is the major type of fuel used in this country? (Very generally, developed countries rely on fossil fuels. Developing countries rely upon a mix of fossil fuels, biomass, and hydropower.)
- Do you think this country's standard of living will increase or decrease in the next 10 years? Why?
- How will an increase in standard of living affect energy use?
- How will population growth affect standard of living?
- How will population growth affect the environment?
- How can the country minimize environmental problems from using and getting energy?

Adaptation

Let participants study their chosen countries more closely before they answer the questions. The library or resources available through exchange and global connections programs can be helpful. You may want to have a visiting foreign exchange student list the things they use back home that require energy. Compare this list with the one generated by participants.

Evaluating Progress

Answers to Activity Sheet 5.1A:

1. United States

2. Haiti

3. Canada, China, Saudi Arabia, South Africa, Russian Federation.

4. United States, Haiti, Brazil, Spain, Germany, Japan, India.

5. Developing countries hold the most people on the earth (over 4 billion). As developing countries produce more goods for their populations, their energy consumption will increase. Developed countries will continue to become more energy efficient. In the future, it is very likely that developed countries will continue to see their share of world energy consumption decrease.

Fair Game

Using the data from Activity Sheet 5.1A, make a graph of energy consumption. You may choose to make a three-dimensional bar graph using foam or other materials. Include other interesting information about global energy use with your display.

One for All and All for One

Some photojournalists have attempted to show the difference in material goods between the United States and other countries by asking families from different areas to put all of their worldly goods in their front yard. They then recorded this "earth statement" on film. Your group members can do a similar photo essay. They may want to photograph all electricity- or oil-requiring items of different families. Your photo essay will help others think about how they use energy and how they can conserve it.

ACTIVITY SHEET 5.1A

Global Lights

Per Capita Energy Consumption, Energy Balance, and Major Environmental Problems of Selected Countries[13]

COUNTRY	Per Capita Energy Consumption (Million Btus)	Energy Balance	Major Environmental Problems
United States	303	Imports 15 percent of energy used.	Air pollution, water pollution, loss of animal and plant habitat.
Canada	31	Exports 25 percent of energy produced.	Loss of forests, loss of animal and plant habitat, ozone depletion.
Haiti	2	Consumes 10 times the energy it produces.	Soil erosion, loss of forests, water pollution (scarce quantities of safe drinking water).
Brazil	22	Consumes about 150 percent of the fuel it produces.	Deforestation, soil erosion, water pollution.
Spain	85	Imports almost 70 percent of the energy it uses.	Air pollution, water pollution, erosion, loss of forests.
Germany	177	Imports almost half of the energy it uses.	Air pollution (acid rain has led to loss of forests), water pollution.
Japan	133	Consumes five and a half times the energy it produces.	Air pollution (acid rain has hurt lakes) and loss of coastal fisheries due to water pollution and overfishing.
China	22	Produces slightly more energy than it consumes.	Air pollution (especially in cities), water supply and pollution, loss of forests, destruction of grasslands.
India	9	Consumes slightly more energy than it produces.	Loss of habitat, erosion, loss of forests, water shortages and pollution, air pollution, sewage in urban areas, loss of plant and animal species.

13 Energy balance, per capita energy consumption figures adapted from *Energy Around the World*, NEED (Reston, VA: 1996).

COUNTRY	Per Capita Energy Consumption (Million Btus)	Energy Balance	Major Environmental Problems
Saudi Arabia	192	Produces six times the energy it consumes.	Coastal pollution (oil slicks), desertification, ground water depletion.
South Africa	66	Exports about 30 percent of the energy it produces.	Water pollution (excessive nutrients in rivers), soil erosion, air pollution, desertification (grasslands turning into deserts).
Russia	183	Produces almost 20 percent more energy than it consumes.	Water pollution, air pollution, soil loss and contamination, loss of plant and animal species.

1. Which country uses the most energy per person? _____

2. Which country uses the least energy per person? _____

3. Which countries capture, harvest, or extract more energy than they use? _____

_____

4. Which countries use more energy than they capture, harvest, or extract? _____

_____

Share of World Final Energy Consumption[14]

YEAR	Developed Countries (%)	Developing Countries (%)
1973	91	9
1980	87	13
1985	84	16
1990	82	18

5. What trend is evident in this table? _____

_____

_____

[14] United Nations Environment Programme, *Environmental Data Report 1993-4* (London: World Resources Institute, 1993), 275. Numbers are rounded.

ACTIVITY 5.2

A MATTER OF INVENTION

Ages: 9 to 18

Style: adult

Life Skills: speaking before a group, understanding and using new technologies, identifying problems, planning for the future, leading change

Pre-Activities: 2.1, 2.2, 2.3, 3.4, 5.1

Time Needed: 30 minutes

Group Size: any

Indoors or Outdoors: either

Materials Needed: copies of Activity Sheets 5.2A and 5.2B cut into cards, art paper, pencils, crayons, markers, toothpicks, modeling clay, papier mâché, glue, craft sticks, other art materials (see Activity)

ACTIVITY GOALS

To discuss global options for alternative sources of energy.

Preview

Participants discuss options for alternative sources of energy and design inventions using these sources.

How to Do the Activity

Ask participants to name their favorite inventions from the last 200 years. Write their responses on a chalkboard or flip chart. Here are some to get you started:

- television
- computer
- CD player
- washing machine
- skateboard
- bicycle
- automobile

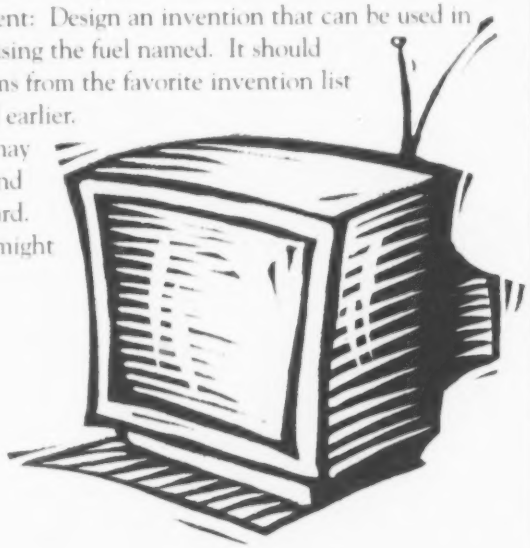
Ask them to name the energy sources used to run these inventions. On the chalkboard or flip chart, draw an arrow from the invention to the energy source. If it's electricity, write down the primary source of electricity in your area, e.g.:

television]——► **electricity**]——► **coal**

Do this for several examples. Point out to participants that historically, as new sources of energy have been discovered, inventions were created to use them. For example, when electricity became widely available, the toaster, television, and stereo became possible.

Ask participants what things might be invented if alternative energy sources were more developed. What would our lives be like if we used alternative energy sources to run our favorite inventions?

Divide the group into teams of three or four. Hand out one prepared card from each activity sheet to each team. Give them the following assignment: Design an invention that can be used in the assigned country using the fuel named. It should replace one of the items from the favorite invention list participants generated earlier. For example, a team may draw a biomass card and Papua New Guinea card. A favorite invention might be a television.



A MATTER OF INVENTION

Therefore, team members would have to design a television that runs on wood or crops that can be used in Papua New Guinea. They would have to speculate whether the fuel is abundant, giving the description of the country. They also should consider whether the invention is energy efficient.

Give the teams art supplies. Have them sketch or build a model of their design. They can make the artwork as elaborate or simple as they wish.

When teams are done, let each share its invention with the group. Do any participants have ideas for improving the invention? Would the invention be widely used in the country it is built for? How difficult would it be to harness the alternative energy source for the invention?

Evaluating Progress

Name some alternative energy sources being used today. What effect would your invention have on people if it were used?

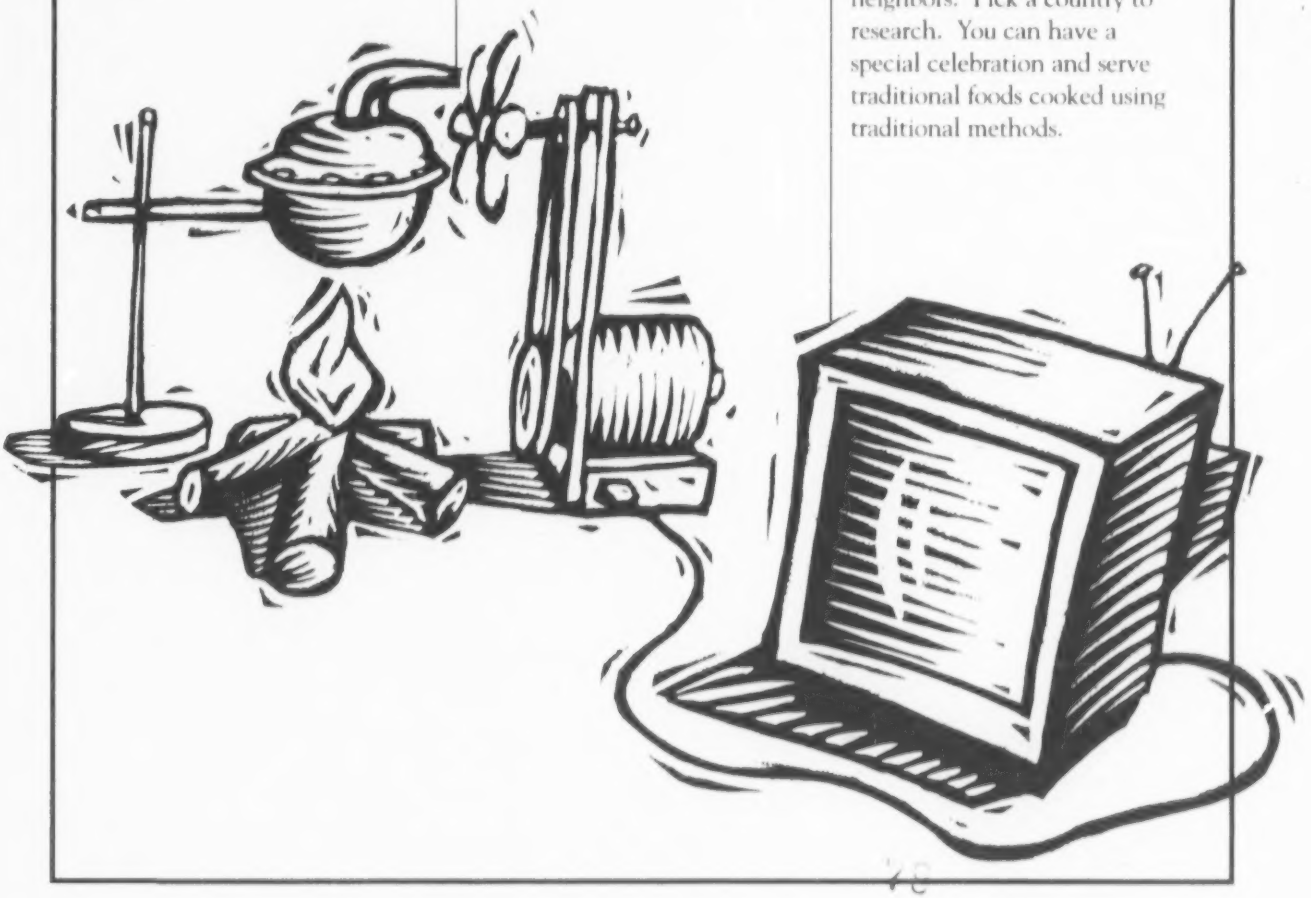
Fair Game

Use your invention as an exhibit! Include information on the energy source, such as availability and how it is generated.

One for All and All for One

Think globally! Energy use is different in every country. Tiny Nepal holds eight of the 10 tallest mountain peaks in the world. Water comes rushing down these mountains, providing the source of most of the electricity in the country. But people who live in Nepal also rely heavily on wood and agricultural residues for heating and cooking. Energy ideas that may be accepted in another country, such as using a windmill to pump water from underground, may not be practical for Nepal.

As a group, become more familiar with our global neighbors. Pick a country to research. You can have a special celebration and serve traditional foods cooked using traditional methods.



ACTIVITY SHEET 5.2A

A Matter of Invention

Wind Energy

Wind energy has been used by people for thousands of years. Today wind holds as much potential as a renewable alternative energy source. There are about 20,000 wind turbines in the United States, generating the energy equivalent of 3.5 million barrels of oil annually. Denmark has more than 2,000 wind turbines. The Netherlands and Germany also use wind energy.

Geothermal Energy

Approximately 40 miles beneath the earth's surface lies a dense layer of gases and molten rock called magma. The heat from this layer can be brought to the surface in the form of steam and hot water. This is used to heat buildings or to turn turbines of a generator to generate electricity. Geothermal systems are used in New Zealand, Iceland, Italy, Japan, the Philippines, and the United States.

Biomass

Biomass has been used since prehistoric times for heating and cooking. Animal fat has long been used for lanterns and other lighting. Today biomass is still the main source of energy for more than half of the world's population. Biomass also can be used to make ethanol.

Solar Energy

Today technologies are rapidly developing to harness the sun's abundant energy for generating electricity and heating. There are about a million solar hot water heaters and 120,000 solar space heating systems in North America. Italy, Spain, and Germany have begun to more fully explore this source of energy.

Hydropower

Moving water is a powerful source of energy. In the United States, about 3.5 percent of all energy needs are met by hydropower. The energy of the rising and falling tides also can be used to generate electricity. France has been using tidal energy for almost 20 years. Norway had the world's first tidal energy plant.

Other

Invent your own alternative energy source. Will it be biomass-based (burning old comic books)? Will it mine other resources (digging in landfills for gas)? Will it come from the North Pole or Mercury? You decide.

ACTIVITY SHEET 5.2B

A Matter of Invention

Thailand

Only 13 out of every 1000 people own automobiles in Thailand. Most Thais live in rural areas and are farmers. Biomass is the major fuel in these areas. In Bangkok, the country's large metropolitan area, commercial energy is generated using fossil fuels such as natural gas.

Greece

Greece relies on imported oil for about two-thirds of its energy supply, although it is trying to develop other sources such as hydropower and coal. Greece has the largest area of solar collectors in Europe. Wind energy stations also have been installed on many islands.

Costa Rica

Hydropower currently accounts for 99 percent of the country's electricity generation. Costa Rica even exports electricity to neighboring countries. Costa Rica is highly dependent, however, on imported oil to fuel its vehicles. Traditional fuels such as wood also account for a large percentage of energy use in this Central American country.

Papua New Guinea

Located north of Australia, this island country depends highly upon wood and agricultural residues for energy. Hydropower also supplies electricity, and the potential for further hydropower development is huge. Papua New Guinea exports oil and has large reserves of natural gas. The population is largely rural and widely scattered.

Uganda

Densely populated, Uganda is located in the heart of Africa. Because it has so many rivers — it contains the source of the Nile — hydroelectricity is a major source of electricity. Still, most of the country relies on traditional fuels such as wood and crop residues.

Venezuela

Venezuela has rich oil reserves and one of the largest undeveloped coal fields in Latin America. It is working to convert its 1,200 billion barrels of bitumen (a heavy hydrocarbon) into inexpensive fuel. Even with all of these fossil fuels, however, Venezuela mostly uses hydropower.

ACTIVITY 5.3

EONS OF ENERGY

Ages: 9 to 18

Style: adult led, teen led

Life Skills: working on a team, facilitating group activities, learning through experience, organizing groups to accomplish a purpose, understanding scientific and technological ideas, observing change in self, families, and communities

Pre-Activities: 1.1, 2.1, 2.2, 2.5, 3.4, 5.1, 5.2

Time Needed: 40 minutes

Group Size: any

Indoors or Outdoors: indoors

Materials Needed: copies of Activity Sheet 5.3A cut into cards, art paper, tape, markers, paints, and other art supplies

ACTIVITY GOALS

To understand changes that have occurred over time in our energy sources.

Preview

Participants design a mural of our energy history.

How to Do the Activity

Divide participants into teams of 10. Give each person one of the cards from Activity Sheet 5.3A. Each group member should share the card information with the rest of the team.

Give participants sheets of art paper. Have them draw scenes that represent the information on their descriptions.

When team members are done with their drawings, tape their sheets together in chronological order. Teams should title their murals and share them with others.

Evaluating Progress

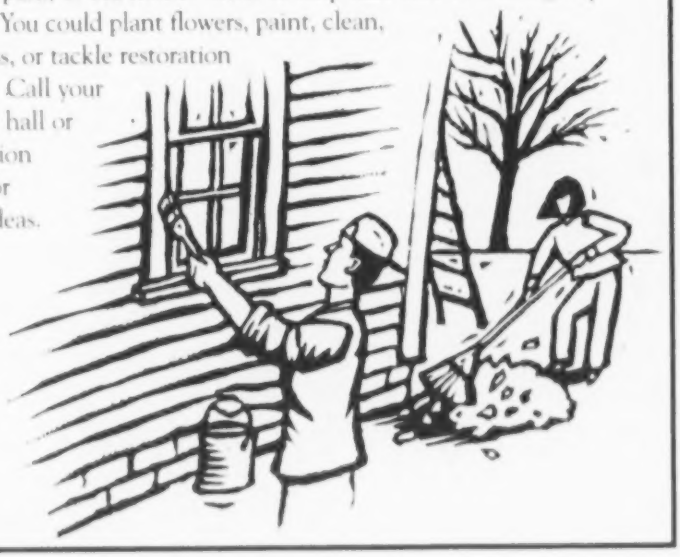
What changes have occurred in energy use over time? (See Energy History Descriptions.) How has this affected lifestyles? (Lifestyles became more affluent — people produced and acquired more things.) Why is energy important to a community?

Fair Game

Research the history of your community. What was life like there 100 years ago? Where did energy come from? Create a display or mural describing the history of your area.

One for All and All for One

Adopt a historical place in your community — a city monument, museum, park, or old home. Offer to help take care of it as a group activity. You could plant flowers, paint, clean, mow grass, or tackle restoration projects! Call your local city hall or preservation society for project ideas.



ACTIVITY SHEET 5.3A

Eons of Energy

Fire and Food **8000 BC**

Since earliest times, humans used energy. The energy our ancient ancestors used was limited to fire and food. Fire gave warmth and light. It cooked and preserved food. Fuel in the form of food provided humans and domesticated animals the energy to do work.

Developing Energy Sources **1 AD**

About 10,000 years ago, humans began farming and learned to use animals, water, and wind to help with their work. Over the centuries water wheels and windmills were invented to grind grain. Sailboats were built to carry people and cargo to other places. Tools and containers were made to help with harvest.

Farming led to the growth of cities where industries turned out products that made life easier. However, each new product took energy to make. The wood that fueled the fires of industry became scarce, and we had our first energy shortage.

Early Lights **1400s**

Light was provided by oil lamps and candles. Most lamp fuel came from pressed olives and other vegetable oils or from whale blubber. Candles were usually made from animal fat. The flickering light from candles was poor compared to the light from the electric bulbs we know today. Several candles or oil lamps were needed to light a single room.

Wells and Mines **1600s**

In the early 1600s, oil wells were established in Europe. Italy and Romania were two of the first countries where small drilling companies sank wells. The owners wanted oil that could be refined into kerosene to burn in lamps. Unfortunately, more wells came up dry than found oil. No one knew then how oil collects underground, so they could only guess where to drill the wells.

Coal **1700s**

As demand rose for new fuels, people in Great Britain, Poland, China, and elsewhere began to dig for coal, a solid black substance created from fossils that burns. Coal was much easier to get than oil and could also replace wood. Coal was used to fuel factories and helped bring about the Industrial Revolution. Later, it fueled locomotives and steamboats. By 1910, many people used coal in place of wood to heat their homes.

Oil **1800s**

Coal was still widely used in the mid-1800s, but businesses began to look to other fuels for their machines. They turned to oil as a major source of energy. From 1860 onward, oil-drilling rigs seemed to spring up overnight in fields, on the outskirts of towns and cities, and even in backyards.

Natural Gas — 1900s

The people who dug oil wells struck natural gas before oil began to flow from the wells. At first, natural gas was considered a waste product, and most of it was burned. Eventually, when people realized the uses for natural gas, they began to collect and actively search for it.

New companies sprang up to lay pipes that delivered gas into cities and towns for businesses. Soon homeowners wanted gas lines laid to their homes for lighting and cooking because the gas burned cleanly and didn't smell, so more pipes were run along streets and into houses. Gas replaced kerosene and other oil lamps in many areas.

Gasoline — 1900s

Oil began to be extracted in quantity and refined into different petroleum products. One of these products, gasoline, later fueled the invention called the automobile. The automobile began to change lifestyles around the world, making transportation quicker and easier than ever before. Cars made long distance travel easier. Trucks soon replaced horses for hauling cargo. Before long, most American families had at least one car. Miles and miles of roads were built to accommodate all the vehicles. People took longer trips and demanded more gasoline.

Electricity — 1900s

Electricity is generated by a turbine turned by steam, wind, or water pressure. During the late 1800s, George Westinghouse, Thomas Edison, and others developed electricity as an energy source and made it available to the public. Shortly after 1879, when Edison invented the incandescent light bulb, electric lighting came into general use in American homes. By 1920, other electrical appliances — toasters, vacuum cleaners, washers — were somewhat common.

Energy Use Today — 1900s

Since 1900, world consumption of fossil fuels has doubled every 10 years. The United States continues to rely on imported oil to fill the gap between energy needs and supplies. Americans are exploring alternative sources of energy to help meet future needs. Nuclear, solar, biomass, geothermal, and other fuels are being discovered or rediscovered for use.

We use fossil and other fuels to light up our holidays, cook our geese, and electrify our lives with music.

ACTIVITY 5.4

HORSES SET COURSES

Ages: 9 to 18

Style: adult led, teen led

Life Skills: listening to others, asking incisive questions, expressing an opinion, asking questions to get information, understanding scientific and technological ideas, comparing and selecting alternatives, making decisions affecting others, anticipating change, thinking about the future, managing resources to achieve a goal

Pre-Activities: 2.1, 2.2, 2.5, 3.4, 5.1, 5.2, 5.3

Time Needed: 45 minutes

Group Size: any

Indoors or Outdoors: either

Materials Needed: copies Activity Sheet 5.4A, pencils

To examine energy predictions.

Preview

Participants discuss predictions based upon facts and trends. They examine a fictional prediction for demand and productivity.

How to Do the Activity

Can we really predict the future? Undoubtedly, participants have heard predictions, often based on current facts or trends, about the future. How many of them have come true? Ask participants to name predictions that they have heard recently or when they were younger. Have any of them come true? Do they expect some of them to be realized in the future? You might want to provide some examples (e.g., people living on the moon, paperless offices, and running out of oil).

Explain that predictions can be very accurate, when variables — things affecting the outcome — remain stable. This is why short-term predictions are usually more correct than those that project trends far into the future.

Because of the many variables involved, it is difficult to predict when we will deplete our fossil fuel resources. Supply and demand come into play here. The price of something generally increases as supply dwindles. As a result, people might begin to conserve or use alternative fuels that might once have been considered too expensive.

Divide participants into teams of three or four. Give each team a copy of Activity Sheet 5.4A. Give teams several minutes to read the information, discuss their options, and fill out the sheets.

After they have finished, ask the teams to share their responses and justifications. Were all variables accounted for when trying to project needs? What actually happened? Did farm productivity increase? (Yes. In the United States during the 1930s, one farmer grew enough food to feed 10 people. By 1990, one farmer could grow enough to feed 120 people.) Why? (Mostly due to use of machinery, advanced technology, and fertilizers and other crop chemicals.) Did our need for hay increase as projected? (No!)

Ask participants to suggest options for meeting future fuel needs as fossil fuels become more scarce. They will mostly fall into two broad categories:

- Shift to other sources of energy
- Reduce energy use
- Remind everyone that the future is now!

Evaluating Progress

What things affect predictions based upon current facts or trends? (Variables and underlying assumptions. If circumstances change or if the assumptions are wrong, the prediction won't be accurate.) Give some examples of predictions and associated variables. What are two options for meeting future energy needs as fossil fuels become more scarce? (Shift to other resources and reduce our use.)

Fair Game

Pick a fossil fuel energy resource (coal, natural gas, or oil) and predict the future. For example, if you've picked coal, what are the current (U.S. or worldwide) reserves? How long will this fuel last based solely on current reserves and consumption levels? What things might affect this prediction? Try to make a reasonable prediction and draw a chart showing future reserves and consumption. Explain any variables.

One for All and All for One

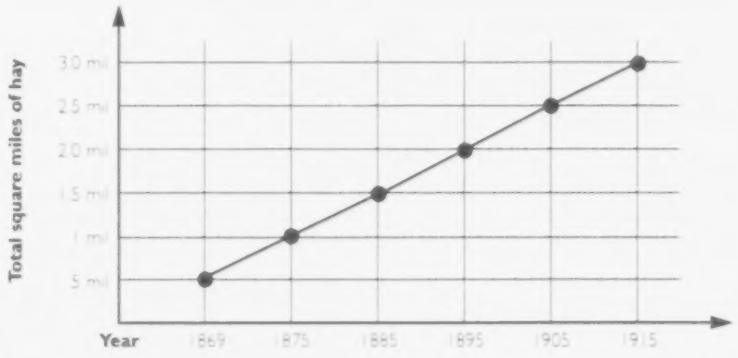
To be a true environmental steward, you have to:

- Think globally. How does your action affect other countries? What does it mean to drive three blocks instead of walking? Which countries are affected? How is their environment and economy affected?
- Look at the big picture, not just the little pieces. Think about energy use, how it affects and is tied to the economy, and how this affects the quality of the environment. Don't just decide to stop buying cafeteria lunch because they use plastic forks.
- Look at the trade-offs involved when you make your school lunch. How much does each cost? Do you use other disposables (e.g.,like plastic bags) that would affect the environment in the same way as the plastic fork? Does the school have economies of scale — can it save money and energy by doing things in large quantities?
- Use reason when making decisions. Many people react emotionally when making decisions.
- Don't assume — know. Books, magazine articles, and classes are great places to get information about the environment, energy, and the economy.

ACTIVITY SHEET 5.4A

HORSES SET COURSES

The year is 1869. You are part of the Future Is Near committee in Washington, D.C. You and your colleagues are trying to figure how to achieve greater economic prosperity for the country. You figure that prosperity is tied to making, transporting, and selling things. (Good conclusion!) Because farm products account for a great percentage of the national wealth, your committee has agreed to focus its efforts on increasing farm productivity. To do this, committee members reason, they need to increase the number of horses available to do farm work. Your committee has proposed a Horse Handout Program that would give farmers free horses based upon farm productivity. The government would raise thousands upon thousands of new horses. Your committee is very pleased with its ideas and actions, until it is visited by a man from Missouri. This gentleman presents a chart that looks like this:



The gentleman expresses concern that too many square miles of hay will be needed to feed all the new horses. He points out that by 1915, there won't be enough land to grow hay to feed all the horses. Why, there aren't even three million square miles of land in the whole U.S.![15] Your committee is very concerned. After all, without horses, farmers can't plant their fields or harvest crops. Horses are . . .well, machinery. And hay is the fuel that makes the horses go. Why, it looks like the plan would create . . .an energy shortage. What should you do?

- ❑ Vote against the Horse Handout Program. Charts don't lie.
- ❑ Vote against the Horse Handout Program. But vote to give money to a study of the situation that will give you more detailed information about your options.
- ❑ Go ahead and vote for the Horse Handout Program. But vote to give some money to researchers who are trying to increase fuel production by making fast-growing hay.
- ❑ Go ahead and vote for the Horse Handout Program. But vote to give some money to researchers who are trying to build machines that can do the work of horses using fuels other than hay.
- ❑ Other (describe) _____

_____

_____

[15] Adding Alaska and other states after 1869 gave the United States a total acreage of 3.6 million square miles.

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Energize Your 4-H Project Area

So far, this guide has provided information and activities to build awareness of energy, economic, and environmental issues. In this section, we focus on what 4-H leaders and young people can do to address these issues in their community:

- Ways to incorporate energy efficiency and conservation into group activities
- Ways to incorporate energy issues into individual projects
- Ways to develop energy related community service projects

By taking action, young people —

- Learn new attitudes toward their community and the environment
- Learn they can make a difference
- Play an important part in solving community problems

Taking Action... in Group Activities

There are plenty of things young people can do to incorporate energy conservation into their everyday lives. Listed below are some ways your 4-H group might begin to work on energy issues.

- Analyze the costs and benefits of having every person bring his or her own mug for refreshments. It might look as simple as this:

  Costs: Hot water heated with gas or electricity to wash mug

  Costs: Inconvenience of remembering to bring each time

  Costs: Soap to wash mug, manufactured and transported using energy

  Costs: Water pollution from soap, which must be treated at a waste treatment plant

  Benefits: Less trash for landfills

  Benefits: Less fuel spent on restocking paper cups

  Benefits: Energy and other resources not needed to make items that are thrown away each time

- Turn off unnecessary lights in the room you are using.
- While taking trips with your group, analyze how much energy is being used. What is the most energy efficient mode of transportation? Walking? Busing? Carpooling?
- Have group members conduct energy audits of their homes (*see Activity 4.2*). Work together to discover how individual members could reduce their energy use. Conduct a similar energy audit of your meetings.
- Dress more warmly (or coolly) to meetings, so you need less fuel for heating or cooling.

ENERGIZE YOUR 4-H PROJECT AREA

- Elect an energy officer for your club. He or she can report on ways the club can analyze energy use and can be in charge of energy projects. Have the officer help your group become more energy conscious.
- Have each person evaluate his or her projects or demonstration ideas for ways to integrate energy themes. Ask 4-Hers: How much energy are they using to construct their projects? How many other resources are being used? They should be aware of these inputs!

Taking Action...in Individual Projects

Young people receive several benefits as they integrate energy, economics, and environmental topics into projects or areas of study. Among others, they —

- Become more conscious of their own energy attitudes and habits, encouraging more environmentally sound behaviors and lifestyles
- Begin to realize that energy is an issue that affects all areas of their lives
- Help others by building public awareness about energy, economic, and environmental issues.

Youth can integrate energy topics into projects through the project's theme, the materials used, or the way the project is conducted.

Although the following suggestions are organized according to 4-H, you can easily use many of them with classroom projects or other youth programs. Remember, too, that this list is not comprehensive. It's a starting point for generating your own ideas.

Animal Sciences

Large Animals

- Study the flow of energy through your livestock operation from grain production to sale of livestock. What energy inputs are required? What energy outputs are produced?
- Plan innovative ways to minimize energy use in your livestock operation.
- Find out what steps are involved in meat processing. At what point is energy used? How could that energy use be reduced?
- Study the use of animal manure as a fuel around the world.

Small Animals

- Study the flow of energy of your animal's feed. Ultimately all energy comes from the sun. How did it get from there to the feed? Once your animal eats the food, where does the energy go?
- Make pet housing and equipment (pet toys, feeders, etc.) from recycled materials. How does this reduce use?

Expressive Arts

Creative Arts

- Express an energy theme or message in your work.
- Design your work using media that reflects an energy, economics, or environmental theme.
- Design logos or graphics for a community energy program.
- Study the flow of energy through the art materials that you use. How were the materials created? What energy inputs were needed? What affect did securing these materials have on the environment?
- Create a weaving, sculpture, or other piece using all reused or recycled materials. How much does this save?

ENERGIZE YOUR 4-H PROJECT AREA

Performing Arts

- Plan a production that incorporates an energy theme.
- Create a clown character around an energy message related to an environmental issue.

Photography

- Study the use of light in photography. How is energy related to light?
- Plan innovative ways to reduce the energy you use in processing your photographs.
- Study the use of batteries in your camera. How are those batteries designed? Are they thrown away? Recycled? What impact do they have on the environment? What are some alternatives? How do costs compare?
- Use a photo story to show steps in an energy process or a community energy project.
- Produce a video about how energy use affects the environment.
- Study how film is made and how this process involves energy. If alternative energy sources were used, would film cost go up? Down?

Home Economics

Child and Family Development

- Make toys that use little energy.
- Write a children's book about energy, where it comes from, and how it is used.
- Pick a favorite toy and analyze how it could be made and transported using only solar energy. How would its cost change?
- Design a game to teach children about energy.
- Make a children's display about energy, showing how to use it properly and how to conserve as much as possible.
- Give a demonstration to children about how energy is used in their bodies.
- Design a kids' calendar to teach dates and an energy topic. Incorporate environmental themes.

Clothing and Textiles

- Study the energy inputs needed to produce fabric. Where does that energy come from?
- Study how oil is used to make synthetic fabrics. How much oil do we use in this country to make these materials? Do we import or export this oil?
- Study the energy use of household appliances (sewing machine, washing machine, iron, etc.). How could these appliances' energy use be reduced? What trade-offs would this involve?
- Create an outfit that would help people reduce the amount of energy they need in their homes.

Consumer Education

- Compare products from an energy standpoint. Look at packaging, energy production, and alternatives.
- Study and display ads for products that focus on an energy theme. Do they contain accurate information? Do they appeal to emotion? Do they incorporate environmental themes?
- Compare various energy saving household appliances. What are the benefits and drawbacks of each?
- Study and make a display showing the life cycle of a consumer product, from basic resource through disposal. Where is energy used in this cycle?
- Invent alternative packaging for products. How much energy do you save?

ENERGIZE YOUR 4-H PROJECT AREA

Food and Nutrition

- Study and display how energy flows through the food we eat. Show the energy path from the sun to you.
- Study the use of energy in food production. How could that energy use be reduced?
- Study the feasibility of everyone on earth growing their own food. How much land would it take? Energy? Other inputs (seeds, water, labor, etc.)?
- Explore the energy used for different forms of a food item (fresh, frozen, canned, dried). Compare this to cost and residues produced.
- Study the impact of fertilizer (made from petroleum) on food production.
- Research the energy inputs required to grow meat products versus fruits, grains, and vegetables.

Food Preservation

- Study and calculate energy costs of home food preservation versus commercial preservation.
- Study the concept of stored (potential) energy. How does this relate to food preservation?

Home Environment

- Conduct a home energy audit. How would you design your home to be more energy efficient?
- Make a display comparing past and present home energy use. How did people wash their clothes? Cool a beverage? Cook food?
- Design a solar heated home, bathtub, etc. What factors do you need to consider?
- Study homes that use alternative types of energy sources. How are they designed? What are the benefits and drawbacks of each design?
- Plan a community service project to establish a home energy conservation program.
- Compare a home task (sewing, cooking, etc.) in the United States with one in another country. What source of energy is used in each country?

Needle Arts

- Design a stitchery piece with an energy message.
- Compare the environmental impacts of natural and synthetic fabrics, threads, and yarns.
- Design a needle arts project using recycled yarn and thread pieces.

Mechanical Sciences

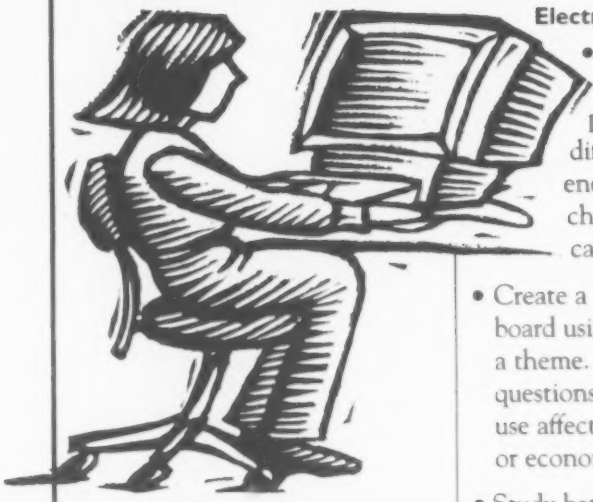
Aerospace

- Study flight and gliders. Make several different glider styles. How does the energy use compare among them?
- Study the energy inputs needed to build a plane. Where does the energy come from? How much is needed?
- Compare the energy use of a plane with that of other forms of transportation. How has this energy use affected our lifestyles and economy?

Bicycle

- Calculate the advantages of bike versus motor vehicle use by charting miles ridden and comparing fuel and air pollutants.
- Make a display showing how biking can help reduce energy consumption. Compare personal energy needed for biking with energy needed to use other modes of transportation. Compare the time to bike somewhere with that of other modes.
- Study the use of the bicycle in other countries. Many countries use bicycles as their main source of transportation. What could your community do to make bicycle transit more popular?
- Study how a bicycle is manufactured. How much energy does it take?

ENERGIZE YOUR 4-H PROJECT AREA



Computers

- Design a software game on an energy issue.
- Design a program to calculate energy use, using a database, spreadsheet, graphics, etc.
- Study the electronic mechanisms that run a computer. How is energy used in running a computer?
- Study the flow of energy in manufacturing a computer. What natural resources are used?
- Where do computers go when they "die?" Are landfills strewn with the remains of XT clones? Trace the life cycle of a computer in your community.
- Calculate the total amount of energy required to keep users on the Internet for one day.

Electric

- Construct an experiment or project to show the different forms of energy (light, thermal, chemical, mechanical, etc.).
- Create a lighted question board using energy use as a theme. You can ask questions about how energy use affects the environment or economy.
- Study batteries and demonstrate how they work. Make a display of different batteries and how they are used.
- Study the production of electricity and the steps taken in that process. What energy and natural resource inputs are needed?

Small Engines/Tractors

- Design an engine and piece of equipment that reduces energy use.
- Compare gasoline to other alternative fuels. How do they compare on cost, performance, and efficiency?
- Study the disposal of motor oil. Where do you dispose of it properly? What happens if it is poured into the ground? Put into the storm sewer? Left in a garage?
- Study the evolution of engines and how changes in energy sources affected this evolution.

Natural Resources

Entomology

- Study the use of pesticides and fertilizers and how energy is used to produce them.

Fishing Sports

- Study water quality issues related to fish populations. How do energy exploration, excavation, and use affect water quality?
- Study acid rain. How is it produced? What effect does it have on fish?
- What are the environmental impacts of using a boat motor versus oars?
- How many miles does a fishing lure travel before it hits the water? Where is it manufactured? Where are the raw materials harvested?

Forest Resources

- Set up a display showing the paper production process and energy inputs needed.
- Study and display the use of forest products to generate energy. What are some current ideas on the use of biomass for energy production?
- Develop a display showing the complete energy cycle of forest resources. Start with the sun and follow the cycle through to decomposition. What are possible negative impacts of collecting large amounts of vegetation for use as fuel?

ENERGIZE YOUR 4-H PROJECT AREA

- Study which countries use wood as a primary fuel. What are the environmental problems of those countries? Is wood economical to use for most families?

Geology

- Display the geologic phenomena that created coal, oil, and natural gas.
- Study and display the geologic techniques used to locate energy resources.
- Study and display how energy resources are extracted and the environmental impact of extraction. Choose one environmental issue and study it in detail.

Shooting Sports/ Wildlife Management

- Study and exhibit current energy sources and their effect on wildlife (e.g., effect of the Alaskan pipeline on caribou herds).
- Clean up a natural area. How has energy use affected this area (e.g., packaging, oil residue, etc.)?
- Investigate the firing process of a gun. What form of energy does it use to move a cartridge?

Wood Science/Shop

- Study and display the complete cycle of a forest product from tree to lumber. What energy inputs are used in this process?
- Design and build something that helps reduce energy use (e.g., a solar cooker).
- Design and build something from recycled plastic. What are the benefits and limitations?

Personal Growth and Development

Citizenship/International

- Interview adults about energy use in the past. What kinds of appliances did they have? Did they have electricity in their homes? How were their lives different from today? What can we learn from this information?
- Develop a plan for an energy-related project with your club or community. Who needs to be involved? How do decisions get made? What can you do to get your project implemented?
- Study the international connectedness of energy issues. Where do we get energy? What environmental problems result from energy use? How do these problems affect other countries?
- Get involved in community energy issues. Talk to local officials. Sit in on county board or committee meetings when energy issues are discussed. Make a display of the public issues and how they have been addressed.
- Study the issue of nuclear energy and spent fuel issues. What social, environmental, and economic factors are involved?

Health

- Study the effect of energy use on human health. What problems are there?
- Study the use of energy in maintaining health.
- Display how we use food to generate energy and how that energy is used to produce work.

Leadership

- Serve as a junior leader to teach energy issues to club members. Develop a lesson notebook.
- Lead a community pride project on energy. Document your involvement.
- Develop a file of games, songs, and skits you've adapted for an energy focus. What resources did you use to insure that the information is accurate?

Plant Sciences

Crop Science/Plant and Soils

- Study and display the life cycle of fertilizers used in crop products.
- Study and display the flow of energy through crop production. Highlight energy inputs in each step.
- Study how sustainable agriculture relates to energy use.

- Construct a compost bin.
- Flower, Indoor, Fruit and Vegetable Gardening.
- Study and display advantages and disadvantages of organic gardening. What effect does this have on energy use?
- Show the flow of energy through the life cycle of a flower or vegetable plant.
- Use reused or recycled materials for planters and vases.

Lawn and Landscape Design

- Compare the advantages and disadvantages of gas-powered and push mowers.
- Compare the energy efficiency of various types of lawn equipment.
- Study the use of fertilizer and its connection to energy use.

Taking Action...in Your Community

One way to help young people become responsible, caring citizens is by providing them with opportunities to look beyond themselves and reach out to others. A service-learning project is an excellent way to go. By taking action, individually and as a group, young people can have a great impact on community energy issues. To tackle a community issue, you'll need a well-thought-out plan and involvement and cooperation from many people. Regardless of how big or small the project is, you'll need to follow some important steps.

Step One:

Brainstorm for Action

1. Brainstorm a list of issues and concerns about energy in your community.

2. Generate a dream list of what could be done.

3. Identify why this is an issue and what barriers keep it from being solved.

4. Brainstorm solutions to those barriers.

5. Identify the people or groups (audience) affected by the issue and its solution, and get them involved.

Below is an example of Step One:

Issue: Very few ride the school bus

Dream List	Barriers	Solutions	Those Affected
Give prizes to people who ride	Principal doesn't support the idea	Have principal serve on planning committee	School Administrators
Conduct a publicity campaign	Don't have money to develop the materials	Get free information from transit providers	Students and teachers
Teach people about the environmental benefits of riding the bus	Large numbers of people hard to reach everyone	Make information part of an all school assembly program	Students and teachers
Make it mandatory that students ride the bus or walk to school	Need to get permission. Also this takes away people's right to choose — what are the rights of individuals versus the rights of society	Work with the school board	School board, students, and teachers

Step Two:

Creating an Action Plan

Once you've identified a project that interests your group and can be done within your allotted time and resources, then create an action plan. You should be able to write out and explain each of the components below:

1. Objective (what we want to accomplish):

2. Audience:

3. What needs to be done:

4. What supplies are needed:

5. People who need to be involved:

6. Who will do what:

7. Time line (dates and target points) of things we need to do:

8. Costs and sources of money and other resources (volunteers, in-kind contributions, etc.):

9. How to measure success:

10. How we will provide recognition for everyone involved:

You may want to encourage youth to assign roles to group members (e.g., organizer, recorder, public relations coordinator, fund-raising coordinator, photographer, phone caller). Be sure the group is initiating a project it can successfully complete in a specific time. It's important to fulfill commitments once a project is begun. It is better to do a small project well than to attempt one that is too ambitious.

Step Three:

Evaluate Your Action

Evaluation shows whether you accomplished what you set out to do. It also gives participants an opportunity to discuss the project and what it has meant to them. Here are some important statements to guide your evaluation process:

1. What we planned to:

2. What we did:

3. What impact it had on our community:

4. What impact it had on the individuals involved:

Be sure to seek newspaper coverage, hand out certificates, and otherwise recognize your effort and participation.

Community Service Ideas:

Each community has unique energy, economic, and environmental issues and community service opportunities. Below are some ideas to begin your brainstorming process. Some of the examples may not work in your community, but they may suggest other workable ideas.

- Conduct energy audits for neighbors' homes and other buildings.
- Help elderly or disabled citizens use mass transit. Show them how to ride and accompany them on trips.
- Volunteer to inflate people's tires at a local gas station.
- Hand out energy information at community fairs or events. Create posters, buttons, T-shirts, and other publicity tools.
- Promote carpooling at local businesses. Develop posters and materials for handouts.
- Teach younger children about energy issues.
- Provide presentations on the environmental impacts of using energy.
- Develop informational posters and displays for local stores about the life cycle of consumer products.
- Sponsor an energy, economics, and environment poster contest for youth in your county or school.
- Conduct a public awareness campaign on how to make wise choices about using energy. Distribute information door to door.
- Develop cable television public service announcements (PSAs) on energy, economic, and environmental issues. Topics might include "Energy Costs" and "Saving Energy, Saving Money."
- Write newspaper articles or produce a community newsletter on energy, economic, and environmental issues.
- Design a brochure on how to conserve energy.
- Survey neighbors to find out how they feel about energy conservation.
- Have older youth read stories about energy issues to younger children.
- Write and perform a play about energy issues.
- Create a promotional campaign for energy conservation in your community.

Train the Trainer

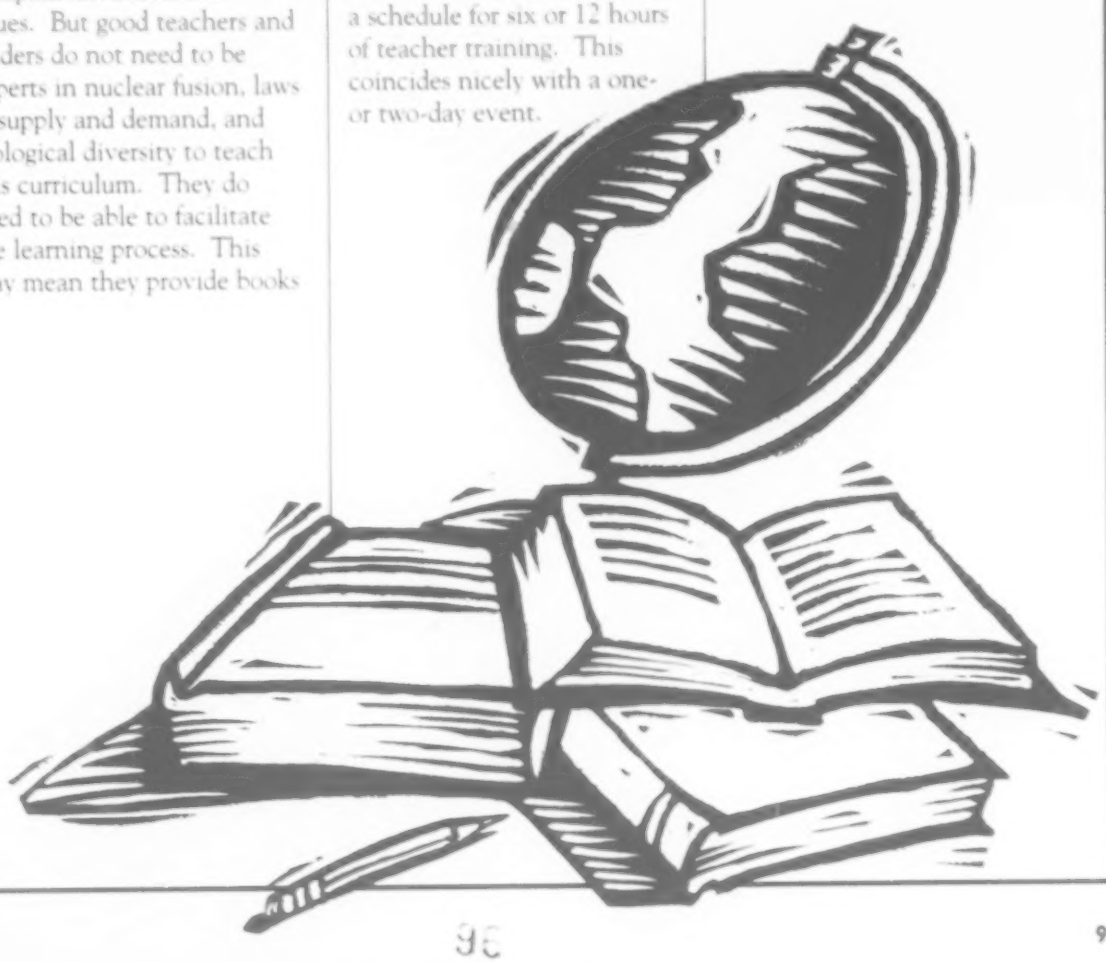
This section is set up to help you train teachers and leaders to work with youth on the issues of energy, economics, and the environment. It contains sample agendas, overheads, icebreakers, and a handout.

Your role as a trainer of teachers is very important. Many people don't feel comfortable teaching a subject in which they don't have content expertise. Teachers and leaders may feel overwhelmed at the thought of helping youth learn about these complex environmental issues. But good teachers and leaders do not need to be experts in nuclear fusion, laws of supply and demand, and biological diversity to teach this curriculum. They do need to be able to facilitate the learning process. This may mean they provide books or other reference materials for self-study. It may mean they arrange for an expert to talk to the group. Facilitators open doors for learning. Facilitators also know it's okay to say "I don't know . . . but let's find out together."

Sample Agendas

The sample agendas provide a schedule for six or 12 hours of teacher training. This coincides nicely with a one- or two-day event.

Prepare for the trainings by reviewing individual activities and chapter backgrounds within the curriculum. Make overheads and handouts. You'll also need to gather materials suggested for each activity.



SAMPLE AGENDAS

Six-Hour Training

9:00 - 9:30	Welcome and Introductions Icebreaker A, B, or C
9:30 - 10:00	Working With Young Children and Environmental Education (see Overhead Sheets A & B) Basic Energy, Economic, and Environmental Concepts (see Overhead Sheets C, D, & E)
10:00 - 10:40	Energy Explorations
10:40 - 10:55	Break
10:55 - 11:30	A Dip in the Pool
11:30 - 12:00	Fact or Foil
12:00 - 1:00	Lunch
1:00 - 1:30	What is a Wilderness Area Worth?
1:30 - 2:00	Auctioning Energy
2:00 - 2:45	A Matter of Invention
2:45 - 3:00	Break
3:00 - 3:30	Horses Set Courses
3:30 - 4:00	Processing, Questions, and Answers

Twelve-Hour Training *(Two Days)*

Day One

9:00 - 9:30	Welcome and Introductions Icebreaker A, B, or C
9:30 - 10:00	Working With Young Children and Environmental Education (see Overhead Sheets A & B) Basic Energy, Economic, and Environmental Concepts (see Overhead Sheets C, D, & E)
10:00 - 10:40	Energy Explorations
10:40 - 10:55	Break
10:45 - 11:15	Energy Diaries (Respondents will record one day's diary and discuss tomorrow.)
11:15 - 12:00	Between a Rock and a Hard Place
12:00 - 12:45	Lunch
12:45 - 1:15	Complete and process Between a Rock and a Hard Place
1:15 - 1:45	What is a Wilderness Area Worth?
1:45 - 2:15	Frozen Pizza or Frisbees?
2:15 - 2:30	Break
2:30 - 3:00	No Wasted Work
3:00 - 3:45	Tennis Shoe Blues
3:45 - 4:00	Processing, Questions, and Answers

Twelve-Hour Training *(Two Days)*

Day Two

9:00 - 9:20	*Discussion: Incorporating Energy, Economics, and Environment Themes Into Your Classroom or Club
9:20 - 12:00	Give the handout to teams (two in each team). Materials needed: posterboard, markers, fabric, battenes, wires, magazines, glue sticks, and other art supplies. Teams use the handout to create a fair or science project related to the themes of energy, economics, and the environment. Includes sharing time.
12:00 - 12:45	Lunch
12:45 - 1:00	Discuss energy diaries, reinforce concepts.
1:00 - 2:30	Eons of Energy
2:30 - 2:45	Break
2:45 - 3:15	Horses Set Courses
3:15 - 4:00	Processing, Summary, Questions and Answers

Energy to Spare

Help participants warm up to each other and start thinking about energy by going through a brief exercise. Begin by giving everyone a copy of the table below. Then ask:

Remember what it was like to be 5 or 6?

How about 7 or 8?

Did you have more energy than you do today?

Well, muster the energy to meet people now! Find people who did the following things when they were 5, 6, 7, or 8. Have them sign their names in the appropriate squares. Try to get a signature in every square. Each person may only sign one square per sheet!

I did energy experiments with your hamster. The more I fed it, the faster it ran in the little metal wheel in its cage. I figured out there was a direct relationship!	I swished a hula hoop using energy obtained from cookies and milk.	I used a magnifying glass and the sun to try to start a fire in a pile of sticks and grass.	I chased an important school assignment as it was blown down the street by the wind.
I sank dozens of toy boats using the great force of water rushing out of the bathtub faucet. I made noises as the boats went down.	I pushed Barbie's brand new car all over my room using the chemical energy from macaroni and cheese.	I discovered that the sun heats dark pavement hotter than light pavement one day while walking barefoot in July.	I discovered potential and kinetic energy when I dropped an egg on my sister's head.
I used chemical energy from the school lunch pizza to soar paper airplanes across the classroom when the teacher wasn't looking.	I roasted marshmallows over a campfire of chemical energy (wood).	I watched the wind shoot dandelion seeds several feet in every direction. So many dandelions, so little time.	I made my swing go higher than my brother's using the awesome energy released by the bologna sandwich I had for lunch.

Energy to Spare

Help your group remember what it was like to be 9, 10, 11, or 12 by playing this icebreaker game. At the same time, you'll be introducing concepts of energy!

Seat participants in a circle *(on the floor is best, sitting in chairs is okay)*. Remind participants that they are to assume the persona of children ages 9, 10, 11, or 12. You might want to remind them of how they behaved at the age *(see Overhead A)*. Above all, they had boundless energy! And they responded to a reward system!

Hand the bowl containing the candy to the first participant. Tell her that she can take a piece of candy if she can say her name and an energy word or phrase that starts with the same letter. Energy words can be sources of energy, words associated with energy, or things that use energy. For example:

- Kevin Kilowatt
- Neng Nuclear
- Edna Energized
- Carolyn Compact Disc Player

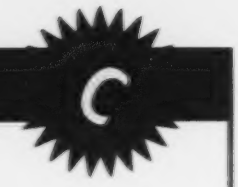
A player may not use the same energy phrase someone else has used.

Play this game for more than one round. Participants may take a piece of candy each time they are successful!

To do this Icebreaker, you'll need:

a bowl

many small wrapped candies



Energy Bingo

Have participants pair with someone who is wearing the same color (e.g., if you are wearing a red scarf, find someone that is sporting red socks, shirt, or even shoelaces!).

Teams don't need to collect the items, but should write the name of the item in the appropriate squares.

Remember, you are a teenager again! Try to think of some of the traits you had at this age. Did you share? Want to hang around with your friends? Demand center stage often?

Find something that uses the **sun** for energy.	Find something that uses **electricity** for energy.	Find something that uses **food** for energy.
Find something that uses **fossil fuel** for energy.	Find something that uses the **wind** for energy.	Find something that uses **biomass** for energy.
Find something that uses **water** for energy.	Find something that uses the **sun** for energy.	Find something that uses **food** for energy.

Overhead A

Developmental Characteristics of Youth Ages 5 to 8[16]

Characteristics	Implications for Leading
Easily motivated, eager to try something new. Live in the present and have a short interest span.	Plan a wide variety of activities. Move quickly from one brief activity to another. Build each experience upon a previous activity. Encourage free time.
All new learning involves use of language.	Be specific and clear with instructions. Ask for feedback to check comprehension.
Sensitive to criticism; don't accept failure well.	Provide positive encouragement and help. Plan many activities in which they can experience success. Set up situations that foster teamwork rather than competition.
Experimental, exploratory behavior is part of development. Learn best when physically active.	Use field trips, real models, and hands-on experience. Provide activities that encourage small and large motor skills, such as running, jumping, painting, and using scissors.
Strong desire for attention and affection of adults.	Have plenty of adults or older teens available as helpers. A ratio of one adult or teen to every three to four children is best.

[16] Adapted from U.S. Department of Agriculture, Youth Curriculum Sourcebook, EPNEP 4-H (Washington, DC: May 1994).

Developmental Characteristics of Youth Ages 9 to 11[17]

Characteristics	Implications for Teaching & Leading
Are active, with boundless energy. Are easily motivated, eager to try something new.	Emphasize hands-on learning. Keep youth busy with individual or group projects and group free time.
Like group activity, but like to be with members of own sex.	Emphasize group learning experiences, especially those done with members of the same sex.
Have interests that change rapidly, jumping from one thing to another.	Encourage many brief learning experiences. Lay out work in small pieces.
Guidance from parents and adults is important if youths are to attend to a task and achieve their best performance.	Provide opportunities for parent involvement. Outline "things to do" and make assignments.
Admire and imitate older boys and girls.	Encourage apprenticing with teen volunteers.
Are extremely curious. Constantly ask "why?"	Don't worry about answering all the questions. Serve as a resources of learning. Help participants use books, libraries, catalogs, and computers to find information.

[17] Adapted from U.S. Department of Agriculture, Youth Curriculum Sourcebook, EPNEP 4-H (Washington, DC: May 1994).

Developmental Characteristics of Youth Ages 12 to 14

Characteristics	Implications for Teaching & Leading
Are concerned about physical development and being liked by friends. Want to be independent, yet still need parents' help.	Encourage learning experiences related to understanding themselves and getting along with others. Encourage apprenticing and working with adults and older teens.
Are self-conscious and may have feelings of inferiority.	Concentrate on developing individual skills.
Are getting over the age of fantasy and beginning to think of what they will do when they grow up, but are unclear of needs and values.	Relate what they are doing to career choices.
Are interested in activities involving boys and girls. Like sports and active games.	Encourage active, fun learning experiences that involve both boys and girls.
Are ready for in-depth, longer learning experiences	Choose tasks that are more difficult and lengthy duration. Provide hands-on and skill-centered experiences in specific subjects.

Developmental Characteristics of Youth Ages 15 to 18

Characteristics	Implications for Teaching & Leading
Have high social needs and desires. Want and need a strong voice in planning their own program. Want adult leadership roles.	Emphasize leadership skills that also relate to social development. Provide opportunities for self-expression. Encourage youth to plan programs with guidance and support of adults. Encourage working with adult role models.
Have areas of interest that are more consistent than earlier, with patterns becoming more definite. Often need guidance in selecting careers.	Encourage greater in-depth study of content, leadership roles, and life skills. Encourage career exploration within specific subject matter.
Are developing community consciousness.	Encourage learning activities involving the community.

OVERHEAD

B

Environmental Developmental Sequence[18]

Ages 1 to 6

During this phase, the self moves away from the mother into the world. The ecological self establishes nature as a safe, predictable place. The self looks for patterns in nature and learns the basic laws by experience (e.g., fall down, get hurt; bees sting). There is an ecstasy in nature that is actually a pure openness, striving to understand. The self comes to understand what the pieces of nature are. The sense is strong that anything that moves is alive. The self is attracted to animals which are humanlike.

Ages 7 to 14

The self begins to appreciate a "community of life." The self moves from an apprehension of wild animals to a growing emotional attachment. A landscape represents a place to play, not an aesthetic pleasure. If the landscape is steep, foreboding, or scary, the self does not like it. The self tends to favor parklike, savannah environments.

Ages 12 and up

Here is the transition from the intuitive sense of belonging to nature to the intellectual sense. The self feels separate from nature, able to survive. Knowledge grows dramatically. The self is attracted to landscapes both for their own beauty and for the potential for risk and excitement. The self appreciates its own setting more than earlier. Activism is strong but is based on a sense of self-preservation. This is where development commonly stops for a person with an average amount of experience in nature, related education, and overall psychological health.

Ages 25 and up

Inherent within each person is the need and ability to feel a oneness with nature in which artificial barriers of self and other are broken down. In peak experience, the self is reintegrated with the environment. Later, the enlightened ecological self moves towards activism, creativity, and education.

[18] Andrew Slade, "Abraham Maslow and the Ecological Self," in *Confronting Environmental Challenges in a Changing World*. St. Paul: (North American Association for Environmental Education, 1991).

Basics of Energy

Energy can be found in many forms.

Mechanical energy makes things move. There are two types of mechanical energy — potential and kinetic. Potential energy is a crystal vase in wet hands. Kinetic energy is the vase falling towards the ground.

Chemical energy is energy stored as chemicals. Food, coal, wood, and other things contain chemical energy. Photosynthesis is the process by which plants convert solar energy to chemical energy.

Electrical energy is charged particles at rest and in motion. Electricity is often generated from coal, moving water, or natural gas.

Radiant energy is light. It also is other forms of waves, such as microwaves, television and radio waves.

Thermal energy is heat. Heat is a form of kinetic energy — the energy of moving molecules. The hotter an object becomes, the faster the molecules move.

Nuclear energy is the energy that binds the nucleus of an atom together. This energy is released when atoms are merged or split apart.

The First Law of Thermodynamics states that energy can't be created or destroyed; it can only be converted from one form to another.

Fossil Fuels

Millions of years ago, the dead remains of arthropods, bony fish, worm-like animals and prehistoric plants settled to the bottom of the ancient seas. They mixed with mud and silt. Eventually, as the earth heaved and buckled and changed, enough pressure and heat was generated to break these primordial remains into chemical compounds of hydrogen and carbon. These are fossil fuels we use today. Natural gas, oil, and coal are fossil fuels.

Fossil Fuels

Wind

Nuclear

Biomass

Geothermal

Hydropower

Solar

Energy is measured using the British thermal unit, or Btu. One Btu is equivalent to the amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit. A wooden match burned entirely gives off about one Btu of energy.

It takes energy to generate energy. Energy production is really energy conversion, not energy creation. Every energy conversion involves some energy loss. You can never get back the amount of energy you started with.

OVERHEAD

E

U.S. Energy Consumption[19]

Petroleum *(includes natural gas plant liquids and crude oil burned as fuel)*	**33.5 Quadrillion Btus**
Natural Gas	**20.3 Quadrillion Btus**
Coal	**18.9 Quadrillion Btus**
Nuclear Electricity	**6.7 Quadrillion Btus**
Hydropower	**2.8 Quadrillion Btus**

The United States Imports (and Exports) Energy.

Net Imports, 1991.

Natural Gas	**1.7 Quadrillion Btus**
Petroleum	**14.2 Quadrillion Btus**
Coal	**-2.8 Quadrillion Btus**

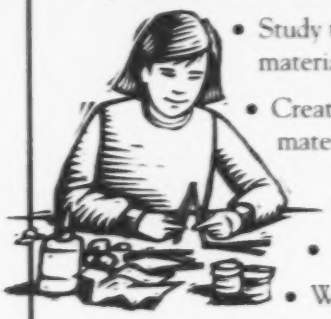
[19] Energy Information Administration, *1992 Energy Facts*, DOE/EIA-0469(92), page 8.

HANDOUT

How will you integrate the topics of energy, economics, and the environment into your club or classroom? Individual fair or science projects lend themselves to incorporation of these themes.

Working with a partner, design a fair or science project using the themes of energy, economics, and the environment. Here are a few ideas to get you started!

Expressive Arts/Creative Arts



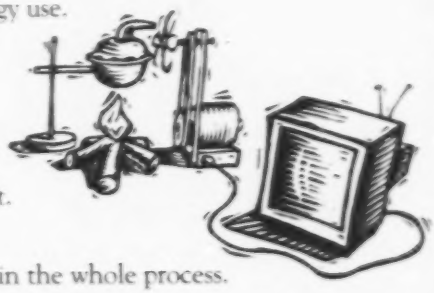
- Study the flow of energy through the art materials you use. How were the materials created? What energy inputs were needed?
- Create a weaving, sculpture, or other piece using all reused or recycled materials. How much energy is saved by doing this?

Child and Family Development

- Make toys that use little energy.
- Write a children's book about energy, where it comes from and how it is used.
- Design a game to teach children about energy.

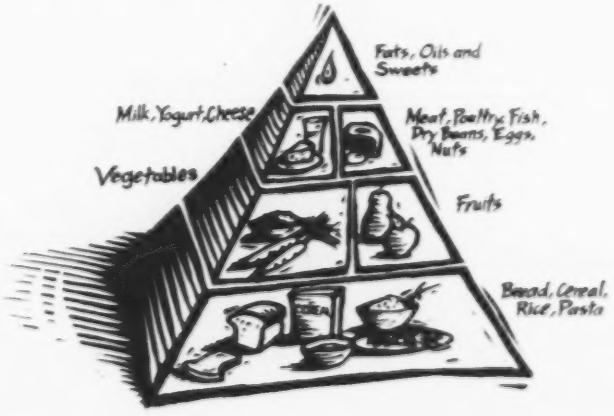
Small Engines/Tractors

- Design an engine and piece of equipment that reduces energy use.
- Compare gasoline to other alternative fuels. How do they compare on cost, performance, efficiency, etc.



Food and Nutrition

- Study and display how energy flows through the food we eat. Show the energy path from the sun to you.
- Study the use of energy in food production. Energy is used in the whole process. How could that energy use be reduced?
- Explore the energy used in a food item purchased in different forms (fresh, frozen, canned, dried). Compare this to cost and waste produced.



notes: _____

Glossary

Barrel: Unit used to measure oil, equivalent to 42 gallons. Each barrel of oil yields 5.25 million Btus.

Biological Diversity: The richness of species, diversity of genetics, and complexity of an ecosystem.

Biomass: Material such as wood, twigs, straw, dung, vegetable matter, and agricultural residues.

Btu: British thermal unit the standard unit used to measure heat. One Btu is about equal to the heat generated by burning one match. It's equal to the amount of heat required to raise one pound of water 1°F. One kilowatt-hour equals 3,411 Btus.

Capital goods: Equipment used to make products (machinery, manufacturing plants, tools, etc.).

Chemical Energy: Energy stored as chemicals in food, wood, coal, and other materials.

Deciduous trees: Trees that shed their leaves annually.

Demand: The quantity of a good buyers are willing and able to purchase (generally obeys the "law of demand": as price falls the demand rises).

Electricity: The phenomena of charged particles. Provides a very versatile form of energy.

Environmental Quality: The quantity and quality of life support products (clean air, clean water, ultraviolet ray protection, habitat, etc.) and amenity services (scenic sites, swimmable rivers, beautiful wildlife, etc.) received by living things directly from the natural resources of the environment.

Export: To transport or ship goods or services from one area into another.

Externality: An involuntarily incurred cost or loss of value.

Extraction: Removal of a resource from where it naturally occurs (e.g., coal from underground).

First Law of Thermodynamics: A natural law that holds that energy can neither be created nor destroyed, only converted from one form to another.

Fossil Fuel: Oil, natural gas, or coal. Fossil fuels formed millions of years ago when plants and animals trapped the energy of the sun as chemical energy.

Import: To bring goods or services into one area from another.

Kilowatt: A measure of electrical power.

Kilowatt-hour: A measure of electrical use. One kilowatt-hour is equal to operating a 100-watt light bulb for 10 hours.

Kinetic Energy: The energy of an object in motion (e.g., a baseball flying through the air).

Mechanical Energy: Energy used to put an object into motion.

Needs and Wants: Goods that ensure our survival or pleasure in our habitat (e.g., food, shelter, water).

Nonrenewable Resource: A resource that cannot be recreated or grown in one or two lifetimes.

Nuclear Energy: The energy in the nucleus of an atom.

Photovoltaic Cell: A device that converts sunlight into electricity.

Potential Energy: Energy that something has because of its location (e.g., a ball at the top of a stairs).

Productive Efficiency: The degree to which a process gets something back for a given expenditure.

Products: Goods and services (e.g., paper, tax preparation).

Propane: A fossil fuel found underground mixed with natural gas and oil.

Radiant Energy: Light and other wave energy.

Quad: A measurement of energy equal to 171.5 million barrels of oil, or one quadrillion Btus of energy.

Renewable Resource: A resource that can be recreated or grown in one or two human lifetimes or cannot be depleted.

Scarcity: A condition where more of a good is desired than is available.

Supply: The quantity of a good sellers are willing and able to offer for sale (generally obeys the "law of supply": as price rises, the supply rises).

Thermal Energy: Heat.

Energy Education Resources

National 4-H Council has produced a wonderful energy resource guide. You may wish to start your search for resources with this publication. *Educating Young People About Energy for Environmental Stewardship*, #ES 1005, National 4-H Supply Service, 7100 Connecticut Avenue Chevy Chase, MD 20815, call (301) 961-2934.

Other Suggested Resources:

Acid Rain Foundation, Inc.
1410 Varsity Drive
Raleigh, NC 27606

Alternative Energy Resources Organization
44 N. Last Chance Gulch
Helena, MT 59601

American Bibliographic Center
2040 Alameda Padre Serra
Box 4397
Santa Barbara, CA 93103

American Coal Foundation
918 16th Street NW, Suite 404
Washington, DC 20006-2902

American Council For an Energy Efficient Economy
1001 Connecticut Avenue, NW
807
Washington, DC 20036

American Gas Association
Educational Programs
1515 Wilson Blvd.
Arlington, VA 22209

American Nuclear Society
North Kensington Avenue
LaGrange Park, IL 60525

American Petroleum Institute
1220 L Street
Washington, DC 20005

American Wind Energy Association
Suite 805
777 North Capitol Street, NE
Washington, DC 20002

Amoco Teaching Aids
Energy Adventure
P.O. Box 1400K
Dayton, OH 45414

Appropriate Energy Technology
U.S. Department of Energy
333 Market Street
San Francisco, CA 94105

California Energy Extension Service
Governor's Office of
Planning & Research
1400 Tenth Street
Sacramento, CA 95814

CAREIRS
P.O. Box 8900
Silver Spring, MD 20907

Center for Renewable Resources
1001 Connecticut Avenue, NW
Suite 638
Washington, DC 20036

Center for Resource Economics Island Press
1718 Connecticut Avenue, NW
Suite 300
Washington, DC 20009

Climate Protection Institute
5833 Balmoral Drive
Oakland, CA 94619

Colorado Office of Energy Conservation
1675 Broadway, Suite 1300
Denver, CO 80202-4613

Conservation & Renewable Energy Referral Service
P.O. Box 8900
Silver Spring, MD 20907

Cupertino Union School District
De Vargas Elementary School
5050 Moorpark Avenue
San Jose, CA 95129

EDC School & Society Programs
55 Chapel Street
Newton, MA 02160

Edison Electric Institute
111-19th Street, NW
Washington, DC 20036

Energy Center
Sonoma State University
Rohnert Park, CA 94928

Energy Education Project
S.U.N.Y. at Albany
1400 Washington Avenue
Albany, NY 12222

ENERGY EDUCATION RESOURCES

Energy Environment & Resources Center
University of Tennessee
327 S. Stadium Hall
Knoxville, TN 37996-0710

Enterprise for Education
1320 A Santa Monica Mall # 202
Santa Monica, CA 90401

Environmental & Energy Study Institute
122 C Street, NW
Washington, DC 20001

ERIC Clearinghouse for Science Math & Environmental Education
The Ohio State University
1200 Chambers Road
Columbus, OH 43212

Fossil Fuels Policy Action Institute
P.O. Drawer 8558
Fredericksburg, VA 22404

Geothermal Resources Council
P.O. Box 1350
Davis, CA 95617

Governor's Office of Energy
State Capitol
Tallahassee, FL 32399-0001

International Institute for Energy Conservation
750 1st Street, NE
Washington, DC 20002

Iowa Department of Education
Grimes State Office Building
Des Moines, IA 50319-0146

Joint Council on Economic Education
1212 Avenue of the Americas
New York, NY 10036

Keystone Center
P.O. Box 8606
Keystone, CO 80435

Massachusetts Audubon Society
Educational Resources Office
South Great Road
Lincoln, MA 01773

NATAS
P.O. Box 2525
Butte, MT 59702-2525

National Council on Economic Education
"Economics and the Environment"
1140 Avenue of the Americas
New York, NY 10036

National Energy Foundation
5160 Wiley Post Way, Suite 200
Salt Lake City, UT 84116

National Energy Information Center
Energy Information Administration
U.S. Department of Energy, EI-231
Forrestal Building, Room 1F 048
Washington, DC 20585

National Hydropower Assoc., Inc.
555 13th Avenue, NW
Washington, DC 20004

National Science Teachers Association
1742 Connecticut Avenue NW
Washington, DC 20009

National Wildlife Federation
1412-16th Street, NW
Washington, DC 20036

National Wood Energy Association
777 North Capitol Street, NE
Washington, DC 20002

NCAT Publications
P.O. Box 4000
Butte, MT 59702

Nebraska Energy Office
Extension Division Chief
P.O. Box 95085
Lincoln, NE 68509

NEED Project
P. O. Box 2518
Reston, VA 22090

New York State Energy Office
Two Rockefeller Plaza
Albany, NY 12223

NTIS
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Nuclear Information & Resource Service
1424-16th Street, Suite 601
Washington, DC 20036

Pennsylvania Energy Office
116 Pine Street
Harrisburg, PA 17101-1227

PG & E
Educational Services
Community Relations Department
77 Beal Street
San Francisco, CA 94106

Renewable Fuels Association
Suite 820
One Massachusetts Avenue, NW
Washington, DC 20001

Solar Energy Industries Association
Suite 805
777 North Capitol Street, NE
Washington, DC 20002-4226

Thomas Alva Edison Foundation
21000 West 10 Mile Road
Southfield, MI 48075

Union of Concerned Scientists
26 Church Street
Cambridge, MA 02238

U.S. Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

WA State Office of Environmental Education
c/o Shoreline District Offices
NE 158th & 20th Avenue, NE
Seattle, WA 98155

World Games Projects, Inc.
University Science Center
3508 Market Street
Philadelphia, PA 19104

Worldwatch Institute
1776 Massachusetts Avenue NW
Washington, DC 20036

Metric Conversion Chart[20]

If You Know	Multiply By	To Find
Length		
inches	2.5	centimeters
feet	30	centimeters
yards	0.9	meters
miles	1.6	kilometers
Area		
square inches	6.5	square centimeters
square feet	0.09	square meters
square yards	0.08	square meters
square miles	2.6	square kilometers
acres	0.4	hectares
Mass		
ounces	28	grams
pounds	0.45	kilograms
Volume		
teaspoons	5	milliliters
tablespoons	15	milliliters
fluid ounces	30	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.8	liters
cubic feet	0.03	cubic meters
cubic yards	0.76	cubic meters
Temperature		
Fahrenheit minus 32	5/9	Celsius

20 From National Bureau of Standards Special Publication 365.

Common Energy Units

Barrel equals 42 gallons of oil. On average, each barrel yields 5.25 million Btus.

Btu (British Thermal Unit) equals about one burning wooden match. One kilowatt hour equals 3,411 Btus.

Cubic feet (cu. ft.) is used to measure dry natural gas. One cubic foot of dry natural gas yields about 1,031 Btus of energy.

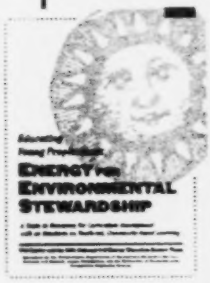
Kilowatt (kW) is a measure of electrical power. A 1kW appliance operating for one hour would consume one kilowatt-hour. One megawatt (mW) equals 1,000,000 watts.

Quad equals 1,000,000,000,000,000 (one quadrillion) Btus of energy. One quad also equals 171.5 million barrels of oil.

Environmental Stewardship

ADDITIONAL PUBLICATIONS

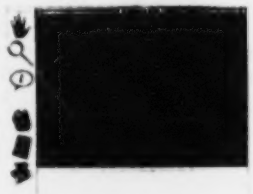
The Environmental Stewardship program helps youth learn how to turn a concern for the environment into action. Through a series of curricula, individuals learn the commitment to responsible resource management that contributes to the quality of life for present and future generations ... and prepares youth for their role in society as environmental stewards.



Educating Young People About Energy for Environmental Stewardship

Aimed at educators interested in using energy as a means for teaching about Environmental Stewardship, this resource contains reviews of curriculum materials currently available. Includes suggestions for relevant lessons regarding energy.

Operation Watershed



A computer environmental game that involves teams of players in a mission to solve environmental problems. Players use collaborative decision making skills as they attempt to solve cases and learn how characters' actions inadvertently cause pollution. Available for Macintosh and Windows.

Mud, Muck & Other Wonderful Things

A curriculum focusing on helping youth ages 5-8 understand basic ecological concepts. Filled with games, scientific experimentation and opportunities for creative expression, the curriculum covers topics such as ecosystems, habitats, water cycles, energy flow and recycling.

CYCLING BACK TO NATURE SERIES

Cycling Back to Nature with Food Production and Pesticides

A curriculum, designed for ages 5 - 18, to help youth understand and evaluate the relationship of pesticides in food production.

Cycling Back to Nature with Biodegradable Polymers

Wrapped in a water soluble, biodegradable plastic bag that can later be used for two of the experiments. This curriculum includes lessons and experiments that teach students to draw their own conclusions about polymer/recycling issues.

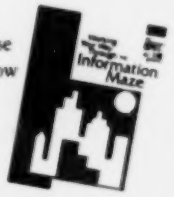
Cycling Back to Nature: Soils Alive from Tiny Rocks to Compost

Hands-on guide exploring Mother Nature's development of soil and soil enhancement through composting. Explores the ins and outs of organic science.

On Common Ground

Environmental Stewardship • Curriculum & Training

The "Information Maze" Kit

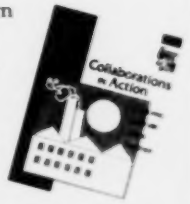


Guide to conducting research on land use and environmental issues. Includes "Know Your Community" data-base software diskette (minimum requirement: Windows 3.0) and an easy-to-use resource guide.

The "Trails" Kit

Details the steps involved in the management of trails from design to maintenance. Includes a video and step-by-step reference book.

The "Collaborations" Kit: Three Case Studies on Land Use Issues



A self-study program to help people learn the skills required to foster successful collaborations. Includes information on forming and steering a group, the "Collaboration in Action" video with real-life examples of collaboration at work and reference guide.

The "Emergency" Kit

Focuses on using collaborative methods for problem solving to help deal with a situation that has reached a crisis stage or when time is too limited for a group to participate in a full two-day workshop. "Facilitation Techniques" and "Planning Process" video and illustrated reference guide are included.

Critical Issues/Critical Thinking

Curriculum for furthering young people's understanding of key issues along with critical thinking/decision making exercises. Ages 12-14.

- Water Quality Poster/Curriculum set.
- Recreational Trails Poster/Curriculum set.
- Wetlands Poster/Curriculum set.
- Endangered Species Poster/Curriculum set.

A curriculum which helps people build skills for collaboration, with emphasis on participation, involvement and practice.

The Building Common Ground Kit

Serves as the core of the whole curriculum as a facilitator training kit for workshop leaders interested in bringing divergent groups together. Includes: Facilitator Cards, Training Guide, Training Modules I-IV, Workbooks for Module I-IV, four real situation land-use videos, "Know Your Community" data-base software, Workshop Medley cassette tape, and custom canvas tote bag.

Building Common Ground workshops are offered throughout the year. For more information please contact us at (301) 961-2904.

NATIONAL 4-H COUNCIL

For information on purchasing products please call (301) 961-2934.

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